RMT

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April 17, 2009

Mr. Richard E. Boice
Remedial Project Manager
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

Subject: Responses to February 19, 2009, EPA Letter Regarding the LTR Monitored Natural Attenuation (MNA) Summary Report

Dear Mr. Boice:

Below you will find your comments and our responses to the above-referenced document.

List of Technical Deficiencies

1. *General: The SVOC, pesticide/PCB and cyanide must be presented and discussed.*

   Response: The groundwater analytical results for semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and cyanide collected during the MNA Demonstration were included in the preceding MNA summary reports and on the disc included as Appendix D of the final summary report. A table is attached (Attachment 1) to show Wisconsin Department of Natural Resources (WDNR) Preventive Action Limit (PAL) and Enforcement Standard (ES) exceedences for these compounds. These results indicate that bis (2-ethylhexl)phthalate (DEHP) exceeded the ES in various wells, including three wells (RM-002D, RM-212I, and RM-212D) that are outside the recognized chlorinated volatile organic compound (CVOC) contaminant plume. Concentrations of DEHP do not appear to be elevated near the source area when compared to the more distal wells. DEHP is a common artifact of sampling due to the pervasiveness of the compound in plastics, including polyvinyl chloride (PVC) (Attachment 2). These detections are not thought to be related to the LTR. Lindane was detected in EW-06D slightly above the PAL. This detection was qualified due to laboratory difficulties, and it is not thought to be attributable to the LTR.

2. *General Comment: The MNA report should follow-up on the Assessment of Remedial Action Effectiveness dated June 2004. There should be a description of the conceptual model for the LL and LTR contamination used in the 2004 report; how this conceptual model has been updated as a result of the bedrock, deeper monitoring well installations, MNA investigations;*

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and the significance of these updates. Examples of RMT's proposed changes to the site model used in 2004 include: long-term release of contaminants from bedrock is likely to be the primary long-term source of groundwater contamination at LTR not a DNAPL; and anaerobic biodegradation is primarily occurring in low permeability bedrock microenvironments (we need a clear definition of this term) while aerobic degradation is occurring throughout the plume.

Response: A description of the conceptual model is presented in the Source Control report. In general, the conceptual model has been refined using additional investigations to develop a complete picture of contaminant transport throughout the history of the site.

The terminology "low permeability bedrock microenvironments" was used to define areas within the bedrock aquifer that are anaerobic and contribute to reductive dechlorination of the contamination. These microenvironments may be associated with low-permeability zones, where oxygenated water does not readily penetrate or flow, or areas where there may be a larger concentration of organic material and microbiological organisms that have consumed available oxygen. Even though the lower permeability restricts groundwater flow through these areas, a small volume of impacted water does flow through, and CVOCs within that water will degrade. Additional degradation from these microenvironments is also expected to occur on the fringes of these areas. The evidence for reductive dechlorination was discussed in detail in Subsection 4.2 of the MNA report.

3. *General Comment: The 2004 and MNA reports, do not address the following elements of a Performance Monitoring Report (see Table 7 of the April 2006 Work Plan): recommended actions; evaluation of institutional controls; relation of trends to remedial goals (i.e. how long will it take to achieve the performance standards); observed changes in land use; discussion of changes in land use and how these changes may affect the remedial actions. Many of these elements can be addressed through corrections to LSRGs institutional control plan.*

Response: The text in Subsection 5.2.2 (that references Table 7) states "The report content will *generally* (emphasis added) include the 'elements of a performance monitoring report' …" and also, "Although the report will *generally* (emphasis added) follow the guidance document suggestions, the report will be organized and will contain information specific to the particular conditions and circumstances at the Lemberger site." The report was not intended to address all of the elements of a performance monitoring report. However, elements of a performance monitoring report are parts of the institutional controls or the source control document.

4. *Executive Summary, par. 2: SVOCs, pesticide/PCBs, and cyanide were also analyzed annually at nine monitoring wells.*

Response: See response to General Comment 1.

5. *Executive Summary, par. 4; Section 4.5.1: The third sentence in par. 4 of the Executive Summary suggests that ethane and ethene were not detected. Actually, ethane and ethane have been detected (e.g. at RM-007D).*

Response: It is assumed that the agency meant "ethane and ethene." In Executive Summary, par. 4, the sentence states that ethane and ethene were not detected "outside of the source area," which is an accurate statement.

Subsection 4.5.1 will be revised to include the following: Ethane and ethene have not been detected in any of the site's monitoring wells except for source area well RM-007D. However, concentrations were only detected in groundwater samples collected during two of the eight monitoring rounds.

6. *Executive Summary, par. 4 and 5; Section 4.3; Section 4.5; Section 4.5.1; Section 4.7: The data does not appear to indicate that significant natural degradation is occurring in the far field plume area for a number of reasons. We agree that the data shows an apparent correlation between the distribution of TIC, $C0_2$, and DO and the groundwater contamination in the landfill and near field plume area. However, the far-field TIC, CO_2, and DO, do not appear to be inconsistent with background concentrations. For example, CO_2 is elevated at RM-4D, and DO is depleted at RM-2D, RM-202I/D.*

Response: The interpretation of the far-field plume data is difficult because of lithologic heterogeneity, and the natural variability in the aquifer geochemistry, and in the location and depth of wells. RMT agrees that there are some well locations that provide exceptions to the general interpretations. The interpretation of MNA data should follow a weight-of-evidence approach and cannot be proved or disproved by the presence or the distribution of any one parameter, with the notable exception of cis-1,2 dichloroethene (DCE). In general, however, the MNA parameters correlate fairly well with the far-field plume distribution.

Specifically, the MNA parameters are consistent with our interpretations except at the following locations:

- RM-4D – Groundwater concentrations of TIC and CO_2 are elevated compared to background. However, concentrations of DO are consistent with the interpretation in the MNA Report. RM-4D appears to be at least partially downgradient of the Ridgeview Landfill. Elevated concentrations of CO_2 were likely detected as a result of the degradation of organic matter from the landfill, or the result of groundwater stagnation beneath the lined and capped portion of the landfill.
- RM-2D – Groundwater concentrations of DO are lower than background, but TIC and CO_2 (although slightly elevated) are within the range of background values. This is consistent with the degradation of 1,1,1-TCA, which is likely occurring upgradient of RM-2D, and which is reducing DO concentrations, but not resulting in large increases in CO_2 or TIC concentrations.
- RM-202I/D – Groundwater concentrations of DO are lower than background, but TIC and CO_2 are within the range of background values. The low DO values at this location are likely due to the overlying clay units (see Cross Section B-B') causing less infiltration of water containing high DO. The recharge area for groundwater flowing to these wells may be sufficiently distant so that DO is depleted when it arrives at these well locations.

7. *The following tabulation indicates that the ratios of daughter to parent compounds are remarkably similar in far-field, near-field, and landfill groundwater.*

LOCATION	*1,1-DCA / 1,1,1-TCA*	*CIS /TCE*
RM-007D (~40 ft bgs)	*0.74*	*3.8*
RM-007XD (~80 ft bgs)	*0.68*	*3.6*
RM-007XXD (139-144 ft. bgs)	*1.5*	*1.7*
RM-208D (~40 ft bgs)	*0.55*	*2.3*
RM-208XD (128-133 ft. bgs)	*0.55*	*4.0*
RM-210D (~60 ft bgs)	*0.55*	*1.7*

Inasmuch as it is unlikely that the degradation rates of the parent and daughter products would be equal, it is probable that the bulk of the degradation occurs very near the landfill, and that the lower downgradient concentrations are primarily the result of dilution. In general, there is a slight decrease with depth and distance from the source, which would be consistent with arrest of anaerobic degradation of parent compounds concurrent with some aerobic degradation of daughter products. Increases in the ratios for 1,1-DCA/1,1,1-TCA at RM007XXD (139-144 ft bgs), and for Cis/TCE at RM-208 suggests that there may be localized

conditions near the landfill and in the near-field plume were degradation of parent compounds predominates. Also see comments from Jim Walden.

Response: RMT agrees that a certain amount of physical attenuation (dispersion) is occurring in the plume and reducing concentrations of CVOCs. However, biotically mediated reductive dechlorination is also ongoing and active in the CVOC plume. The evidence for this process is that there is wide distribution of cis-1,2-DCE and 1,1-DCA. The production of cis-1, 2 DCE and 1,1 DCA occurs solely from biotic dehalogenation of TCE. The ratios of parent to daughter products were used to illustrate locations where this process was actively occurring. Graphs showing trends in the ratios of cis-1,2 DCE to TCE and 1,1 DCA to 1,1,1 TCA are included as Attachment 3.

These graphs illustrate the complexity of the system, but again, an apparent spatial relationship increased ratios in the source and near-field wells as compared to the far-field wells, as shown on the attached Figure A1, which illustrates the ratios of cis-1,2 DCE plotted at monitoring well locations. If, as suggested, reductive dechlorination was the only degradation process and it was occurring only in the source area, the ratios would be relatively uniform throughout the plume. However, the higher ratios of reductive dechlorination breakdown products in monitoring wells near the source indicate a depletion of breakdown products with respect to the parent compound with distance from the source. This is likely caused by a slowing of the reductive dechlorination and an increase in aerobic degradation, which would result in comparatively more rapid degradation of the breakdown products, as suggested.

In addition, the source and near-field wells more commonly show a steady increase in the ratio of cis-1,2-DCE to TCE with time, and the far-field wells generally show a decrease. This suggests that the wells closest to the source are still being supplied with organic carbon to fuel reductive dechlorination, while the more distal wells are becoming more depleted of organic carbon and generally more aerobic. This supports the concept that biotic activity is ongoing and, since the trends change spatially, they are not the result of dilution.

8. ***Executive Summary, par. 6 and 7; Section 4.6.2; Section 5.1, bullets 8: Further evaluation is needed to determine whether residential wells that are cased to 250 feet bgs, can draw in contamination from 190 feet bgs, especially because these wells are used for both residential and agricultural purposes. This evaluation could be incorporated into the institutional control plan.***

Response: Based on our discussion, RMT, on behalf of the LSRG, will be performing additional data evaluation as it relates to the protectiveness of the special casing area requirements. The results and any updates to the casing requirements will be included and discussed in the Institutional Control Plan.

9. ***Executive Summary, par. 7; Section 5.1, bullets 1 and 6: Because the pump-and-treat system has never contained the source area and a capture zone evaluation has not been performed to fully evaluate the extent of groundwater capture by the downgradient pumping, the available data can not be used to indicate the contaminant distributions and trends that would result from an effectively operating pump-and-treat system. The first objective of a pump-and-treat system is to contain the contaminated groundwater by pumping out contaminated groundwater and inducing flow towards the pumping wells. The groundwater more distal from the pumping wells cleans up first, if the upgradient contaminated groundwater is diverted towards a pumping well and is replaced by clean groundwater, which further removes contaminants from aquifer solids as it flows towards the pumping well. Also see comments from Jim Walden.***

   <u>Response</u>: As discussed in the March 17 meeting at RMT, the pump-and-treat system was never designed for containment; rather, it was designed for source removal. As agreed in our meeting on March 17, RMT is currently evaluating the use of a pump-and-treat system as a containment option, and these results will be submitted under separate cover.

10. ***Section 3; Section 5.1, bullet 10; Appendix A: RMT concludes that DNAPL was "not evident beneath LTR", and suggests that the continued VOC contamination is from release VOCs that diffused into the bedrock matrix back to the groundwater. This is a change from the conceptual model proposed in the 2004 report, which included a DNAPL in the source area. This change appears to be inconsistent with the detection of VOCs as deep as 190 feet below ground surface at RM-007. Because water level measurements indicate very little vertical gradient at RM-007 there does not appear to be a significant mechanism for downward migration of contaminants in this vicinity other than sinking of a DNAPL.***

   <u>Response</u>: The intent of this statement was not to imply that DNAPL has never been present or has not played a role in the distribution of CVOCs in groundwater. The statement was meant to document that there has been no <u>direct</u> evidence of free-phase solvents or solvent concentrations that are within the 1 percent solubility that is typically used to suggest NAPL, either during removal actions or in borings placed immediately outside the LTR. Their presence must be surmised based on the weight-of-evidence. The revised conceptual model is detailed in the Source Control Report; a brief summary follows:

   – CVOCs entered the landfill via disposal of bulk liquids containing CVOCs in trenches at the LTR.

- DNAPL from the disposal trenches migrated downward through unsaturated soil and rock to the water table and below into the saturated dolomite beneath the LTR.
- The DNAPL adsorbed to the soil and bedrock and diffused into the rock matrix while migrating downward. CVOC concentrations are now contained within the matrix porosity and may no longer constitute a separate NAPL phase.
- Back-diffusion of the CVOCs results in groundwater concentrations detected in the vicinity of the LTR and downgradient.

11. *Section 3, Bullet 8: This bullet asserts that RM-7XXD and RM-208XD are appropriately placed as deep sentinel wells. According to the workplan, if the groundwater sample collected from the borehole for RM-7XXD at an approximate depth of 140 bgs is above WDNR Enforcement Standards then the borehole was to be advanced another 20 feet and another sample collected. The borehole was to continue to be advanced incrementally at 20-foot intervals until a groundwater sample was collected with concentrations at or below the groundwater Enforcement Standards. According to the letter report on the deep monitoring well installation, samples were collected from two intervals at the RM-7XXD borehole, 139 to 144 feet bgs and 188-194 feet bgs, which are separated by more than 40 feet. This deviation from the approved workplan needs to be acknowledged and explained. The consequence of this deviation is that the well installed at RM-7XXD (as well as RM-208XD) may be screened up to 20 feet below the depth that one would have wanted the well to be screened.*

    Response: RMT agrees that this was a deviation from the workplan; however, based on the elevated concentrations of the initial screening sample, RMT decided to advance the boring an additional 40 feet, because it was likely that the next 20 feet would be impacted as well. Additional groundwater data collected from these two wells following their installation have confirmed that the wells are screened at the appropriate depth.

12. *Section 4.1.1; Section 4.4: In Section 4.4, RMT attributes the apparent change in plume direction to mixing (dispersion) of clean upgradient water in the LGU with the western flank of the plume, which "orients the plume in a north-south direction". This appears to be an attempt to explain why hydraulic data indicates that RM-2 should be at the center of the downgradient plume, but the contaminant data indicates that RM-2 is clean, and the center of the plume is at about RM-210. However, considering that most of the contamination remains in the bedrock aquifer, which does not readily mix with the LGU, it is not clear how dispersion related to the LGU would "orient" the plume in the bedrock aquifer in a north and south direction. Furthermore, if groundwater from the contaminated bedrock groundwater migrates into the LGU where the bedrock dips north of LTR, the change in groundwater flow*

direction from NW to NE occurs, but not because of mixing or dispersion, but because of the change in advective flow direction.

Response: We agree that the plume direction is consistent with the advective groundwater flow direction. Since the source of the groundwater impacts originates in the bedrock, the TCE impacts move horizontally and flow into the LGU, as the bedrock dips to the north. RMT agrees that, if groundwater from the bedrock migrates into the LGU, then the change in groundwater flow direction from northwest to northeast would not be related to mixing or dispersion.

13. *Section 4.1.2: To demonstrate whether groundwater flow directions do or do not change with the season, potentiometric surface maps are needed for a high (spring) and low (winter) water level periods. Only the map for July 2008 was provided.*

    Response: RMT has provided additional groundwater contour maps to demonstrate consistent groundwater flow directions (Attachment 4).

14. *Section 4.1.3: The text states that there is an [sic] constant upward gradient at RM-5I/D, but the Appendix C plots do not appear to show an upward gradient.*

    Response: Agreed. There is no upward vertical gradient at that location. The text will be revised.

15. *Section 4.1.3: It is not clear why being near the Branch River would create a vertical gradient at RM-210I/D. Other well nests that are nearer to the Branch River do not show this relationship.*

    Response: The vertical gradients at the site are localized and generally very small. Based on our interpretation of the groundwater/surface water interactions of the Branch River, there are locations where groundwater discharges to the river, and locations where the river recharges groundwater. It is likely that these areas are temporally/seasonally dependent and are also dependent on the screened elevations of the monitoring wells. Overall, however, vertical gradients are inconsistent and rather minor, and have little bearing on the plume dimensions or migration.

16. *Section 4.2: Inasmuch as ratios of parent to daughter concentrations are used as evidence for degradation, a table with the ratios (e.g. TCA to DCA and TCE to cis-DCE) needs to be provided to support the conclusions in this section. Note that according to the summary table in Appendix F at a number of wells, there is no trend in parent compound concentrations.*

Response: Trend plots and a table with the ratios of parent to daughter compounds are provided in Attachment 3.

17. *Section 4.5.1 and 4.5, 5th Bullet: It is unclear how RMT determined that twice background concentrations of chloride should be expected from reductive dechlorination at LTR. Should we expect mg/l range increases in chlorides from degradation of ug/l concentrations of CVOCs? Can you differentiate the chloride produced by degradation of CVOCs from chloride leached from the waste or from dissolution of road salt?*

Response: We agree that the source of chloride in the wells cannot be determined, but it is useful as a tracer of landfill impacts, whether produced by degradation or leached from landfill waste. Again, analysis of MNA data is a weight-of-evidence exercise, and it is agreed that the distribution of chloride in and of itself is not always evidence of MNA. Please note that the original groundwater concentrations of CVOCs at the source area were greater than 1 ppm. Using a mass balance approach, a TCE concentration of 1 ppm could produce 0.2 ppm of chloride from dechlorination.

18. *Section 4.5.1, Dissolved Oxygen, Nitrate: Inasmuch RMT proposes that the distribution of dissolved oxygen and nitrate depends on whether or not a clay confining unit underlies the LGU, a map is needed showing where a clay confining unit underlies the LGU, and where the LGU is in direct contact with bedrock.*

Response: A figure that delineates the extent of the clay-confining unit and the bedrock is attached (Attachment 5).

19. *Section 4.6, par. 1: A summary of how the trends presented in Appendix F were evaluated is needed, including a.description of the confidence levels used and how nondetect values were handled. The results in the trend analysis summary table needs to be discussed.*

Response: The trend analysis was performed using Sen's Slope Analysis at a 90 percent confidence interval. The Sen's test is a two-tailed test; i.e., it evaluates the data for evidence of either an increasing or a decreasing trend. Therefore, the 90 percent confidence interval for the two-tailed test is equivalent to a Type I error of α=0.05 for detecting just an increasing trend in the data (comparable to a 1-tailed test). The Sen's test is a nonparametric test, and therefore is not sensitive to or skewed by data sets having a high percentage of nondetect values. For the Sen's test, the detection limit was substituted for nondetect results, which is more conservative than substituting either half the detection limit or zero for nondetects, when the goal is to detect increasing trends in the data.

The trend analysis was performed for 1,1,1-TCA; 1,1-DCA; 1,2-DCE; and TCE at wells having historical detections of these VOCs. The analysis was performed at each of these wells on all of the historical data collected through July 2008, and also on the subset of results collected since the MNA demonstration began. The trend analysis summary in Attachment 6 shows that only six of the wells evaluated (RM-4D, RM-7D, RM-7XD, RM-209D, RM-306D, and RM-307D) had one or more VOCs that exhibited increasing trends in the full historical data set. However, since the MNA demonstration began, the data for these same wells and constituents have exhibited no increasing trends in concentrations. As shown on Attachment 6, since the MNA demonstration began, most of the wells exhibit no trend in the VOC concentrations, or in a few instances, the VOC concentrations have continued to decrease. There is no evidence that the shutdown of the groundwater extraction system is resulting in a rebound of VOC concentrations.

20. *Section 4.6, par. 2; Section 5.1 bullet 4: The first sentence states that 1,1,1-TCA and TCE concentrations are decreasing at all wells. According to the summary table in Appendix F at many wells, there is no trend. The summary table also does not identify an increasing trend in 1,2-DCE at RM-208I or RM-203I.*

Response: Note that the locations where the statistical analysis indicates "no trend" exhibit very low concentrations and concentrations below detectable limits. Therefore, an increasing detection limit would result in an increasing trend and would misrepresent the actual data.

However, the text will be revised to say "most wells." The text will also acknowledge that the intermediate wells (also with very low or nondetectable concentrations) typically show no trend because varying detection limits skew the data.

21. *Section 4.6, par. 3: In the last Sentence, the meaning of the statement that the increasing trends are not significant is unclear because according to the summary table in Appendix F, some trends are statistically significant.*

Response: The trends may be statistically significant, but the analysis included nondetect values (treated as detections at the detection limit) that were often elevated. However, we will remove the statement. See previous comment and response.

22. *Section 4.7; Section 5.1: Many of the conclusions drawn are poorly supported. Overlay maps showing each of the distribution relationships that provide evidence of natural attenuation would be helpful.*

Response: A map for several of these parameters is attached (Attachment 7).

23. *Section 5.1, par. 1: It is unclear what evidence there is for the occurrence of anaerobic microcosms in an otherwise aerobic aquifer other than the general evidence that both aerobic and anaerobic degradation processes are occurring in the plume. Further explanation supporting the presence of and describing the characteristics of the anaerobic microcosms is needed. RMT further asserts that "natural processes are capable of maintaining active degradation". What is the evidence for this assertion? There was no evaluation of sustainability of the degradation processes in this summary report.*

Response: RMT based our interpretation on 10 years of data that show that the plume has maintained consistent shape and is declining in concentration. Additional evidence is as follows:

- The presence of cis-1,2-DCE indicates that microbial-driven reductive dechlorination is occurring at the site.
- Low DO concentrations along the CVOC plume suggest that anaerobic conditions are likely within the aquifer. This most likely occurs at the source area, but it is also likely that it occurs in very localized, possibly microscopic, areas within the aquifer where biotic activity has induced reducing conditions using CVOCs as an electron donor.
- Elevated concentrations of CO_2 within the source area and downgradient indicate that there are areas where anaerobic degradation occurs.

RMT believes that the degradation is sustainable because it has been occurring for 10 years as demonstrated by the reduction in concentrations and the consistent plume distribution. Furthermore, as illustrated in Attachment 8, the ratios of parent to breakdown product are increasing in source area and near-field wells, indicating a sustainable reductive environment.

24. *Section 5.1, bullet 1: According to Section 6.1 of the 2004 report, a model prepared in 1998 was adapted for use in contaminant transport modeling. The 1998 model was prepared to assess the hydraulic capture of the original pump-and-treat system, and was also used to design the expanded pump-and-treat system, which included installation of a new pumping well at the northern edge of LTR and near the southwestern edge of LL to enhance the VOC capture in the source area. Although VOC concentrations were very high in the new boreholes along the*

northern boundary of LTR, pumping tests indicated that flowrates were much lower (≤1 gpm per borehole compared to the model estimated 25 gpm). Considering this, the model used by RMT is discredited because the hydraulic conductivity of the bedrock aquifer in the LTR source area is grossly unrepresentative of actual conditions. EPA is not aware of any subsequent attempt to evaluate the extent of groundwater capture of the LTR source area.

Response: We agree that the model was never recalibrated based on the results of performance testing of the extraction wells that were installed in 2002 and is therefore not an appropriate tool to assess source area capture zones. Capture-zone simulation in the source area would require the simulation of small-scale features within the bedrock (i.e., irregular fracture patterns and fracture connectivity) in order to calculate the resulting 3-dimensional capture zone associated with pumping at very low flow rates, i.e. 0.1 gpm. We do not believe that this is possible based on the lack of defined and interconnected fractures, as described in the bedrock investigation report. However, we do not believe that a recalibration of the flow model to better simulate the source area would significantly alter the conclusions of the contaminant transport modeling.

The contaminant transport modeling was an effort to simulate the fate and transport of the plume in the relatively near-field and far-field wells. The calibration of the groundwater flow model and the extraction well performance tests are consistent, indicating that there is no reason to believe that the near-field and far-field groundwater flow field would need to be recalibrated. Since the source area was simulated as a model boundary condition (i.e., constant concentration), reductions in hydraulic conductivity within the source area flow field will result in no significant change to the conclusions of the contaminant transport modeling.

25. *Apparently most of the groundwater flow in the LTR source area is in bedrock fractures, but these fractures are sparse in that area, and difficult to characterize. The slow release of contaminants from bedrock to the fractures would be expected to result in a large dilution factor. Dilution by clean groundwater from the LGU downgradient from LTR was also not modeled. This dilution was indicated to be significant in Section 4.4 of the MNA report. Both the sparse groundwater fractures in the LTR source area, and the LGU downgradient dilution, would make dilution much more significant than estimated in the model. As a result, the model should not be used to assess the dilution rate, nor the rate of contaminant removal by degradation. Considering the aquifer conditions, it appears to be impractical to accurately model LTR area groundwater containment or contaminant transport.*

Response: Several different, but related, issues are included in this comment. We have separated them in order to address each one as clearly as possible.

a) ***Apparently most of the groundwater flow in the LTR source area is in bedrock fractures, but these fractures are sparse in that area, and difficult to characterize.***

We agree with the characterization of the bedrock in the source area.

b) ***The slow release of contaminants from bedrock to the fractures would be expected to result in a large dilution factor.***

We also agree with the USEPA's characterization of the dissolved solvent being released slowly from the higher concentrations into the rock matrix. This mechanism was not explicitly simulated by the model, but it was incorporated into the model through the selection of the source boundary condition in the model. This was done by specifying the concentration of TCE flowing in the bedrock fractures (*i.e.*, post-transfer from matrix to fractures) as the source concentration rather than specifying the concentration in the rock matrix and then attempting to model the transfer.

c) ***Dilution by clean groundwater from the LGU downgradient from LTR was also not modeled. This dilution was indicated to be significant in Section 4.4 of the MNA report.***

In laminar flow, such as we typically see in groundwater settings, dilution occurs through the mechanisms of mechanical dispersion and diffusion. Because diffusion is typically small with respect to the scale of a groundwater plume, these terms are typically combined into one term referred to as the coefficient of dispersion, which is the product of the groundwater velocity and the model parameter, "dispersivity." The contaminant transport model used a dispersivity that was based in part on literature references, and in part on model calibration. There is no mechanical mixing of groundwater under laminar flow conditions; therefore, we believe that the two mechanisms of dilution were appropriately simulated in the model in the near-field and far-field model domain.

d) ***Both the sparse groundwater fractures in the LTR source area, and the LGU downgradient dilution, would make dilution much more significant than estimated in the model.***

As described above, these are two separate issues. "Dilution" of the high concentrations in the source area rock matrix was incorporated into the model source concentration. "Dilution" of the plume downgradient from the LTR was simulated directly by the model through the use of the dispersivity parameter.

e) ***As a result, the model should not be used to assess the dilution rate, nor the rate of contaminant removal by degradation.***

We believe that the model can be used to estimate contaminant fate and transport (including dispersion and degradation) in the near-field and far-field wells. As previously stated, the source area concentration is a model boundary condition and should not be considered part of the model simulation, but rather part of the model conceptualization and implementation. Downgradient dispersion and degradation was simulated explicitly by the model and was part of the model calibration. The fact that the downgradient plume calibrated well with the observed plume, using site-specific and reasonable literature-derived model parameters, is a strong indication that the contaminant transport model provides a reasonable assessment of the contaminant fate and transport.

f) ***Considering the aquifer conditions, it appears to be impractical to accurately model LTR area groundwater containment or contaminant transport.***

We agree that the model does not contain sufficient detail and that it is impractical to sufficiently characterize the bedrock system to accurately model groundwater containment at the edge of the LTR. We also agree that model predictions adjacent to a model boundary (*i.e.*, the model source term) are overly constrained by the boundary itself. However, we believe that the model provides a reasonable representation of the plume in the near-field and far-field wells.

26. *Section 5.2: The list of the proposed 53 monitoring wells for hydraulic monitoring is needed. The monitoring proposal for metals, cyanide, SVOCs, and pesticide/PCBs is needed. A list of the sixteen MNA parameters is needed.*

<u>Response</u>: Table 8 has been revised to address these comments (Attachment 9).

27. *Section 5.2, bullet 2: Because the LL does not appear to be contributing to the LGU and bedrock aquifer contamination, there is no reason to tie initiation of the long-term monitoring to the LL Leachate Head Evaluation Study. Furthermore, MNA parameters are not part of the LL Leachate Head Evaluation Study.*

<u>Response</u>: We concur.

28. *Section 5.2, last par: The meaning of "optimize" is unclear. Explain how you propose to optimize sampling. Does RMT proposed to adjust monitoring based on sampling results, or that there would be actual optimization exercises?*

    Response: The meaning of "optimize" was stated in the section. It refers to the process of making improvements to the system, including considerations for removing or adding wells, and for changing the frequency of sampling in response to temporal changes in constituent concentrations or distribution and types of analytical parameters. No changes will be made to the monitoring program without prior notification to the USEPA.

29. *Table 1: There should be a tabulation and discussion of SVOC/pesticide/cyanide results.*

    Response: See response to General Comment 1.

30. *Figure 2: Monitoring wells RM305D, RM308D, and RM211D have concentrations greater than 2 ug/l, but are shown outside the 2 ug/l isoconcentration contour.*

    Response: Figure 2 has been revised (Attachment 10).

31. *Figure 4: Monitoring well RM305D, has a concentration greater than 0.5 ug/l, but is shown outside the 0.5 ug/l isoconcentration contour.*

    Response: Figure 4 has been revised (Attachment 10).

32. *Figure 14: DO value for RM-10D should be added to the plot.*

    Response: Figure 14 has been revised (Attachment 7).

33. *Executive Summary, par. 3: The term "stable trend" is incorrectly used to mean no detectable trend. Either the data shows no detectable trend or it shows an increasing or decreasing trend.*

    Response: "Stable trend" should not have been used to describe the data sets that exhibited no trend based on the Sen's test. The summary trend table in Attachment F of the report correctly listed these data sets as having "no trend."

34. *Executive Summary, Fourth Paragraph and Section 4.5: It is unclear which wells are included in the "source area bedrock wells". In the past (as well as in this document) wells have been referenced as near field and far field wells. It is unclear whether the list of source area wells is different from near field wells.*

Response: The "source area bedrock wells" refer to those wells in the immediate vicinity of the LTR (south of Sunny Slope Road) that are installed in bedrock. These include RM-7D/XD/XXD, RM-209D, RM-303D, RM306D, and RM-307D. The near-field bedrock wells are all located north of Sunny Slope Road and include RM-3D, RM-8D, RM-208D/XD, RM-211D, RM-213D, and RM-214D.

35. *Section 4, bullets 1 and 2: The difference between biotically mediated and biologically-mediated needs to be explained.*

Response: There is no difference in the meaning of the two terms. Both terms mean that dechlorination is associated with microbial activity.

36. *Section 4.2, bullet 2: According to the summary table in Appendix F, a decreasing trend in total 1,2-DCE (not Cis) was identified at in RM-007D and RM-307D, but not at RM-303D.*

Response: We note that the original text incorrectly states that the trends of DCE are *increasing* in those three wells. That is only true for RM-007D, and the text will be revised. We understand that the trends are hard to distinguish, so trend lines are provided on the graphs (Attachment 11).

Please note that, while the isomers of 1,2-DCE were not reported prior to the MNA demonstration project, subsequent analyses demonstrate that the "trans" isomer is rarely present. It is reasonable to assume that the "trans" isomer was also rarely present in the past, making it a reasonable assumption that the "total" 1,2-DCE is essentially the same as the cis-1,2-DCE as currently reported. Attachment 12 is a printout of all of the trans-1,2-DCE ever detected in any of the groundwater analyses.

37. *Section 4.2, bullet 7; Section 5.1, bullet 4: The "site wells" need to be listed.*

Response: The "site wells" refer to all wells that are in the monitoring program. For clarity and completeness, the text should be revised to read "Concentrations of parent compounds (TCE and 1,1,1-TCA) are decreasing at most wells at the site where they are present at detectable concentrations."

38. *Section 4.4, 2nd Paragraph: There is no Figure A-1 in Appendix A. Should the reference be to B-1 in Appendix B?*

Response: Agreed.

39. *Section 4.5.1: RMT misuses the term "increase" because it implies that an increase in concentration versus time is needed to support occurrence of reductive dechlorination. Apparently, what is intended is simply that if groundwater concentrations of TIC, TOC, Mn, Fe, Cl, or SO_4 exceed background, it supports occurrence of reductive dechlorination.*

Response: An increase relative to background is the same as saying the concentration exceeds background. RMT will revise the text as "elevated" with respect to background.

40. *Section 4.5.1, Total Organic Carbon: The different categories of wells needs to be clarified. Shouldn't RM-307D be considered a source area well not a near field well?*

Response: Agreed. RM-307D is a source area well, but it is more sidegradient than downgradient.

41. *Section 5.2, par. 1: There is no Table 10. Is the correct reference Table 8?*

Response: Table 8 is correct.

42. *Figures 13 and 14: Some of the outlying data points are shown very faintly.*

Response: The figures have been revised (Attachment 7).

43. *Appendix E: The trend plots do not appear to be in any special order, and this makes the review more difficult. If the trend plots in Appendix E are not to be in numerical order of the wells, provide pagination and a table of contents for the plots.*

Response: The trend plots will be reordered numerically.

Sincerely,

RMT, Inc.

Kristopher D. Krause, P.E.
Senior Project Manager

Attachments

cc: Mr. Gary Edelstein – Wisconsin DNR
Mr. James Walden – Wisconsin DNR
Mr. Doug Clark – Foley & Lardner
Mr. Nilaksh Kothari – Manitowoc Public Utilities
Mr. James Wallner – Red Arrow Products Co., Inc.
Mr. Louis Meschede – Newell Rubbermaid
Ms. Juliana Ruenzel – City of Manitowoc
Mr. Tom Reed –Manitowoc Public Utilities
Mr. Tim Reis – The Manitowoc Company, Inc.
Mr. John Lang – Quantum Management Group, Inc.

Attachment 1
Summary of SVOC, Pesticide/PCB, and Cyanide Data

Summary of Semivolatile and Pesticide Organic Groundwater Standard Exceedences at
During Monitored Natural Attenuation Demonstration
Lemberger Landfill Sites
July 2006 - July 2008

WELL ID	DATE	PARAMETER	RESULT (µg/L)	DATA QUALIFIERS	STANDARD[1] (µg/L) ES[2]	PAL[3]	EXCEEDENCE
EW-06D	7/23/2006	BIS(2-ETHYLHEXYL)PHTHALATE	36		6	0.6	ES
EW-06D	7/23/2006	GAMMA-BHC (LINDANE)	0.024	P	0.2	0.02	PAL
EW-08D	7/23/2006	BIS(2-ETHYLHEXYL)PHTHALATE	49		6	0.6	ES
EW-09D	7/23/2006	BIS(2-ETHYLHEXYL)PHTHALATE	39		6	0.6	ES
RM-002D	7/30/2007	BIS(2-ETHYLHEXYL)PHTHALATE	90		6	0.6	ES
RM-002D	7/7/2008	BIS(2-ETHYLHEXYL)PHTHALATE	17.7		6	0.6	ES
RM-203D	7/30/2007	BIS(2-ETHYLHEXYL)PHTHALATE	78		6	0.6	ES
RM-203D	7/7/2008	BIS(2-ETHYLHEXYL)PHTHALATE	7.9		6	0.6	ES
RM-203I	7/30/2007	BIS(2-ETHYLHEXYL)PHTHALATE	58		6	0.6	ES
RM-203I	7/7/2008	BIS(2-ETHYLHEXYL)PHTHALATE	27.6		6	0.6	ES
RM-210D	7/24/2007	BIS(2-ETHYLHEXYL)PHTHALATE	17		6	0.6	ES
RM-210D	7/7/2008	BIS(2-ETHYLHEXYL)PHTHALATE	21.8		6	0.6	ES
RM-210D DUP	7/7/2008	BIS(2-ETHYLHEXYL)PHTHALATE	15.6		6	0.6	ES
RM-210I	7/24/2007	BIS(2-ETHYLHEXYL)PHTHALATE	97		6	0.6	ES
RM-210I	7/7/2008	BIS(2-ETHYLHEXYL)PHTHALATE	44.7		6	0.6	ES
RM-212D	7/30/2007	BIS(2-ETHYLHEXYL)PHTHALATE	46		6	0.6	ES
RM-212D	7/9/2008	BIS(2-ETHYLHEXYL)PHTHALATE	16.4		6	0.6	ES
RM-212D DUP	7/30/2007	BIS(2-ETHYLHEXYL)PHTHALATE	67		6	0.6	ES
RM-212I	7/30/2007	BIS(2-ETHYLHEXYL)PHTHALATE	92		6	0.6	ES
RM-212I	7/9/2008	BIS(2-ETHYLHEXYL)PHTHALATE	75.5		6	0.6	ES

Notes:

(1) Table includes exceedences where the reported concentration is between the Limit of Detection and the Limit of Quantitation (J data qualifier).

(2) ES = Wisconsin Administrative Code NR140 Enforcement Standard.

(3) PAL = Wisconsin Administrative Code NR140 Preventive Action Limit.

P = The relative percent difference between the two columns for detected concentrations was greater than 40%.

Attachment 2
WDNR Memorandum Concerning DEHP

Problems Associated with bis(2-ethylhexyl)phthalate Detections in Groundwater Monitoring Wells

WISCONSIN DEPT. OF NATURAL RESOURCES

Waste & Materials Management
P .O. Box 7921
Madison, WI 53707-7921

Pub. - WA 1011-2002

Description: This document provides guidance for investigating whether phthalate detections in monitoring wells are false exceedances or real groundwater contaminants, and the application of NR 50716, NR 507.17, NR 507.28(3), NR 508.05, NR 140.16 in these situations.

Guidance manager/Contact: Jack Connelly, Solid Waste Program Coordinator

Applicability: This guidance primarily is intended for evaluating the need for assessment monitoring when di-(2-ethylhexyl)phthalate is detected in monitoring wells at landfills regulated under NR 507 Wis. Adm. Code. In addition, it may be applicable to landfills for which corrective action is necessary or cases where NR 507 and NR 716 may both be applicable. The recommendations contained in this guidance may have general applicability to site investigations, brownfields, or remediation sites; however, it is not intended to supersede Superfund guidance or existing guidance in the Remediation and Redevelopment program related to acceptable levels of contamination.

Problem Statement:

Consultants, facilities, and staff have had questions about the validity of bis(2-ethylhexyl)phthalate in landfill monitoring wells, particularly when it is the only contaminant detected.

Bis(2-ethylhexyl)phthalate is a semi-volatile organic compound (SVOC) that is also known as di-(2-ethylhexyl)phthalate, and DEHP. Some DNR programs refer to this compound as BEHP; however, this is not a recognized synonym in many chemical databases. Using this acronym can cause confusion because in scientific literature, BEHP usually refers to butyl(2-ethylhexyl)phthalate (cas number 85-69-8). Although DEHP has been identified as a common laboratory contaminant, phthalates are prevalent in the environment because of their use in plastics like PVC. Groundwater monitoring plans may include SVOCs when facilities investigate elevated indicator parameter concentrations, leachate results indicate possible problems, special circumstances at a landfill raise concerns or a general site investigation is being performed by the Department or others. Data in GEMS indicates that most detection limits reported are at or above the NR 140 Groundwater Quality Preventive Action Limit (PAL) of 0.6 ug/L, so almost every quantifiable result is a PAL exceedance. This guidance attempts to lay out the problems and appropriate approaches to assessing whether with phthalates are really present in the groundwater or an artifact of the sampling and analysis procedures (in other words, a false exceedance). We have reviewed a number of reports for Wisconsin sites and queried other states for their experience with this problem.

Recommendations

Whether DEHP is detected during assessment monitoring or in conjunction with other monitoring done at a site, staff should ask the facility to investigate whether the DEHP is a false exceedance attributable to sampling or laboratory procedures.

If sampling procedures or field conditions are identified as contamination sources, the facility should be instructed to change their sampling procedures to eliminate the contamination source. This may mean changing sampling equipment, materials or collection method. Although some have proposed filtering as a means of excluding DEHP particulates from sampling, there is a general consensus that **filtering samples is <u>not</u> an appropriate option.**

If the source of DEHP is attributed to laboratory contamination, the facility should be directed to obtain additional analyses for which laboratory contamination is controlled. The facility may need to switch laboratories if their laboratory is unable to control contamination adequately.

If the facility is requesting the cessation of assessment monitoring and DEHP is the only substance detected above the NR 140 PAL and the facility has demonstrated that DEHP is a false exceedance as per 508.05(1), then staff may allow the facility to discontinue assessment monitoring. If the concentrations of DEHP cannot be fully attributed to a false exceedance, staff should consider whether it is more appropriate to discontinue assessment monitoring or to propose alternate assessment monitoring as provided in NR 508.05(2) and (3)(a).

If the facility has not begun assessment monitoring, DEHP is the only substance detected above the PAL and there are no other reasons for assessment monitoring, then it would not be necessary for the facility to initiate assessment monitoring.

Suggested Approach to Determine the Credibility of DEHP Detects

Given the prevalence of DEHP in the environment and the high potential for contaminating samples, the source of DEHP in groundwater cannot be dismissed automatically as sampling or laboratory error. It may be necessary to modify sampling plans to incorporate additional blanks and to change sampling protocols. Ultimately, any corrective action or requirements for assessment monitoring will need to be based on evaluation of all available information and the applicable rules.

Assess Blank Results

<u>Method blanks</u> are useful for determining whether laboratory procedures introduced any contamination into the analysis. Although facilities are supposed to flag data when a contaminant is detected in the method blank, you should not rely solely on the flag in assessing the source. Experience has taught us that data is not flagged reliably and even when flags are present, the concentration of the contaminant in the method blank may not be reported or available in GEMS. If method blank results are available and the concentration of the blank is less than 5% of the sample concentration, the DEHP concentrations in the sample may be biased high, but cannot be attributed entirely to laboratory contamination. If the concentration of the sample is in the same range as the method blank, sample results may be the result of laboratory contamination. If the concentration of the method blank is near the detection limit or less than the limit of quantitation and sample results are in the same range, we suggest that sample results could be attributed to contamination. <u>If method blank results exceed the LOQ, the facility should take steps to obtain sample results under circumstances in which laboratory contamination is better controlled.</u>

<u>Field blanks</u> may be quite useful in determining whether sampling is contributing contamination. You should be clear about how these blanks were collected and what they represent. To the extent possible, field blanks should be collected in the same manner as the samples, i.e. be exposed to the same equipment and materials as the samples. In evaluating these results, you may need to consider what water was used for a field blank. If the water in the blank is from the same container as was used to clean equipment and without additional information, it may not be possible to determine whether the water or the sampling equipment is the source of contamination.

Rinsate blanks may also be useful indicators that sampling is the source of DEHP. As with field blanks, investigators should be clear about what rinsate blanks represent. Typically, these blanks are collected after equipment is cleaned and represent potential carry-over between sampling stations. These blanks may also provide an indication of rinse water contamination if this blank is from the same source as the rinse water.

Trip blanks are not generally collected or used for semi-volatiles and may have limited use in evaluating the source of the contamination because DEHP does not volatilize at an appreciable rate. These blanks typically are supplied by the laboratory and accompany samples without direct exposure to field conditions.

Change Sampling Procedures

Although evaluating blanks is an important first step in investigating sources of contamination, not all procedural problems result in contaminated blanks. The History section below highlights possible sampling artifacts that are not easily proven or addressed. Obviously, any equipment or supplies that are plastic or are in contact with plastics should be carefully evaluated. It may be necessary to choose another sampling procedure and compare results. For instance, if investigators believe that bailing is causing abrasion to the well casing or that the well casing is flaking, it may be wise to sample using a pumping procedure. Because DEHP adheres strongly to any particulates, filtering the samples is not an acceptable modification to sampling procedures nor can it be used to "prove" that the source of DEHP is the well casing.

Other Considerations

In addition to evaluating blank results, facility or staff investigations of DEHP detections should include the following considerations:

- What about well construction materials?
  Is the piping or casing PVC or other plastic?
  Is the piping or casing steel?

- Is there other evidence that the landfill is leaking?
  - Are indicator parameters elevated or do they show a trend?
  - Are VOCs present? (VOCs may increase DEHP solubility)
  - Are petroleum contaminants present? (As with VOCs, gasoline and other petroleum products can act as a solvent for DEHP)

- Is there a pattern to the detected values?
  - Is it detected in the leachate?
  - Was it detected in background or up-gradient wells in the "same" concentration range?
  - Has it been detected historically in the affected wells?
    - Are detected concentrations consistent over time? Are they erratic?
  - Were affected wells constructed in the same time period?

Evaluating whether the detected concentrations in the down-gradient wells are the "same" as background wells can be somewhat subjective. Usually there is only one result per sample, so investigators may not be able to determine the variability associated with sampling and laboratory analysis adequately. Absent other information and as a rule of thumb, down-gradient results two to five times the concentration in the background well may be considered to be in the same concentration range. This evaluation can easily be complicated if blanks also show contamination. Frequently, there are insufficient data to apply statistical techniques to determine whether differences are significant. For instance, to understand and assess the variability in various data points, multiple analyses of the same samples may be necessary. Before using a statistical approach, it is important to consider the underlying principles and assumptions of the statistical tool proposed to assure that it can be applied appropriately to the data set.

History – Sites Where DEHP is Attributed to Sampling

After detecting DEHP in groundwater monitoring wells at concentrations in excess of the NR 140 PAL, a number of consultants and laboratories performed investigations to determine whether the source was sample contamination. The investigations generally ruled out laboratory contamination as the source because method blanks were either free of contamination or the concentrations of DEHP in the method blanks were much lower than concentrations in the samples. The investigators have attributed detects in the wells to degradation (aging) of the well casing, microbial action (iron bacteria) on sample tubing and abrasion on well casing, bailer and rope associated with bailing procedures.

At this point, contamination from sampling cannot be attributed to any single sampling technique. At one facility using bailers, the field collection personnel reported that visually turbid samples seemed to be a predictor of phthalate concentrations. Subsequent analyses of scrapings from the bailer and ropes indicated the presence of DEHP. They proposed filtering samples as a means to more accurately assess the true DEHP concentrations in the wells. At another facility where sample crews used low-flow pumping and collected field blanks, investigators visually examined tubing that had been dedicated to sampling an affected monitoring well and noted the presence of black mucilaginous material on the walls. Field blanks collected through new tubing did not contain detectable DEHP concentrations; however, blanks prepared using the tubing dedicated to the well contained significant concentrations of DEHP.

During Superfund Site Inspections in Northeast Region, DNR staff found phthalates both in groundwater and rinsate samples, regardless of the site under investigation. The investigators traced the phthalates to contaminated rinse water. They tested water directly from the still and found that it, too, contained high phthalates so contamination could not be attributed solely to storing the rinse water in plastic carboys. There are sites, however, for which phthalate concentrations cannot be attributed to sampling or laboratory analysis.

Additional Chemical Information and Environmental Fate of Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate (CAS Number 117-81-7) is one of several common names for 1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester. DEHP is common in the environment because of its use in plastics. Sampling and laboratory equipment, monitoring wells, and waste disposed in landfills may contain or be constructed of plastics. In addition to its use in plastics, DEHP is also used in inks, adhesives, coatings, pesticides, cosmetics, vacuum pump oil and as a dielectric fluid in ballast capacitors and other electrical equipment (e.g., transformers).

DEHP has low solubility in water (300 - 400 μg/L), is soluble in most organic solvents, and evaporates slowly into the air. In the environment, DEHP will attach strongly to soil particles or humic material. Although DEHP may biodegrade under aerobic conditions (e.g. in lakes or rivers), DEHP has not been shown to degrade in anaerobic conditions, such as landfill leachate. Additional information on DEHP, its environmental fate and toxicity can be obtained through EPA's Chemical Registry System (CRS) by searching for the compound and following the Related Links at the end of the compound listing (http://www.epa.gov/crs). The TOXNET web site accesses several chemical databases and is also good source of information. http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?TOXLINE

Contact 608/266-2111 or DNRWasteMaterials@Wisconsin.gov for further information.

Disclaimers: This document is intended solely as guidance and does not include any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any manner addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

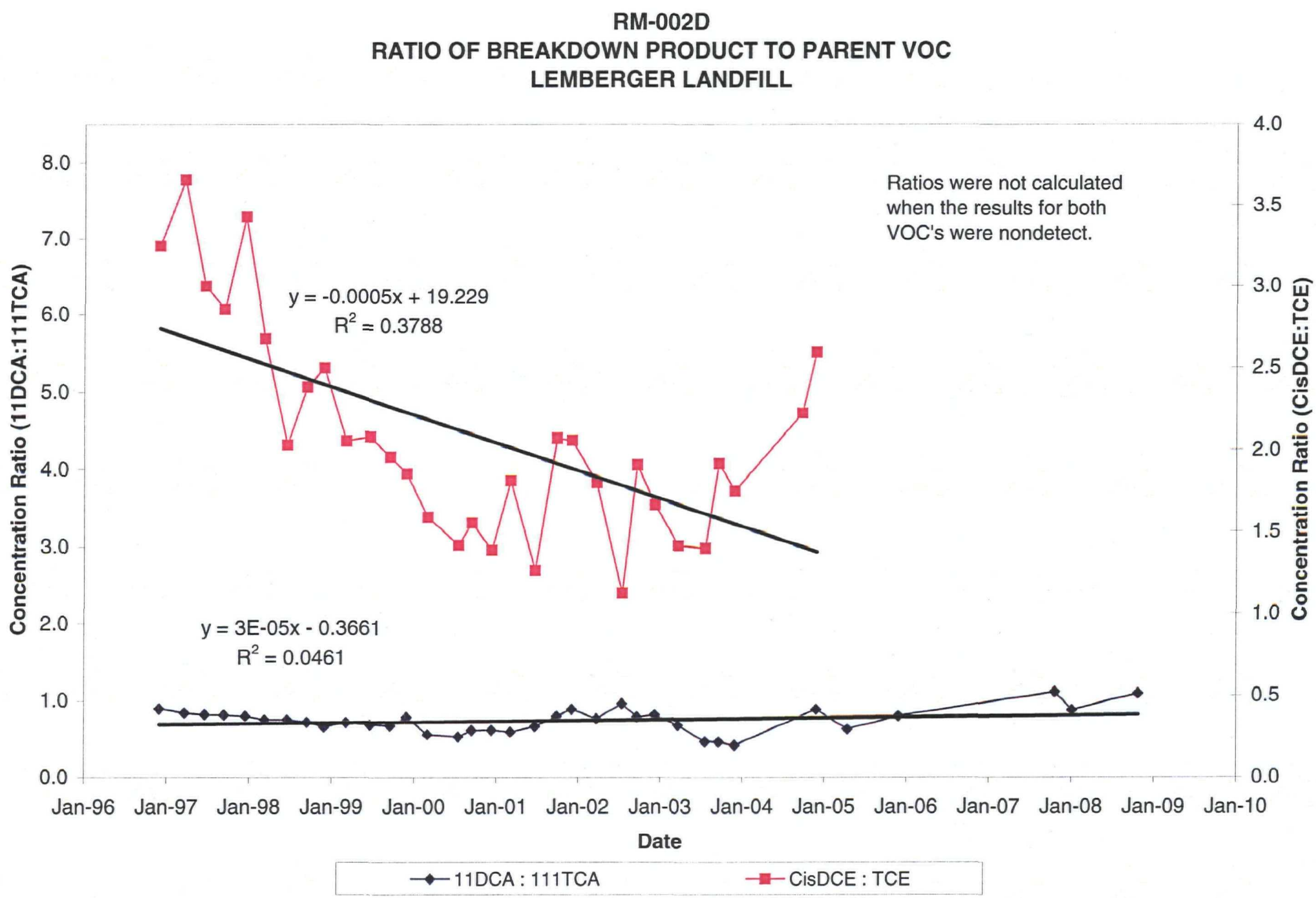
Attachment 3
Graphs of TCE/cis-1,2 DCE and 1,1,1 TCE/1,1-DCA Ratios Through Time

Ratios of Concentrations of Volatile Organic Compounds
From Most Recent Sampling Event at Each Well
Lemberger Landfill

WELL	DATE	RATIO OF 1,1-DICHLOROETHANE TO 1,1,1-TRICHLOROETHANE	RATIO OF CIS-1,2-DICHLOROETHENE TO TRICHLOROETHENE
EW-01D	7/23/2006	0.4717	2.8065
EW-03D	7/23/2006	0.4394	1.8000
EW-04D	7/23/2006	0.4059	1.3793
EW-04I	7/23/2006	0.4389	1.2727
EW-06D	7/23/2006	0.5904	3.3571
EW-07D	7/23/2006	0.4138	2.5532
EW-08D	7/23/2006	0.5610	4.8571
EW-09D	7/23/2006	0.3947	3.0800
RM-002D	10/27/2008	1.0909	2.5926 (11/30/2004)
RM-002I	4/4/2008	0.7143	1.8542 (10/26/2007)
RM-003D	10/31/2008	0.4960	2.2791
RM-003I	10/31/2008	0.7097	1.6000
RM-005D	10/29/2008	0.4403	2.8857
RM-005I	11/7/2008	0.4514	1.8571
RM-007D	10/30/2008	0.6242	3.3013
RM-007XD	10/30/2008	0.5037	3.6096
RM-008D	10/29/2008	0.3049	2.6471
RM-010D	11/3/2008	0.3750	1.7292
RM-101D	11/5/2008	0.9583	0.7545
RM-103D	11/4/2008	0.3458	2.9091
RM-103S	11/4/2008	0.8333	4.5783
RM-203D	10/23/2008	0.4510	1.3514
RM-203I	10/23/2008	0.3667	2.0408 (6/26/2001)
RM-204D	10/31/2008	0.5685	1.8889
RM-204I	10/31/2008	0.4911	1.5000
RM-208D	10/29/2008	0.3949	2.8387
RM-208I	11/6/2008	0.4688	2.6923 (7/24/2003)
RM-209D	10/30/2008	0.5978	3.4468
RM-210D	10/23/2008	0.5699	1.7368
RM-210I	10/23/2008	0.4470	1.5417
RM-213D	10/29/2008	0.1500	2.1818
RM-214D	10/29/2008	0.4076	7.8235
RM-303D	10/30/2008	0.8416	2.5041
RM-304D	11/4/2008	0.1563	1.8182 (10/7/2002)
RM-305D	11/4/2008	0.3261	1.3175
RM-306D	11/5/2008	0.3039	0.5692
RM-307D	11/5/2008	0.4661	1.0504

Notes:

Ratios were not calculated when the results for both VOC's were nondetect.



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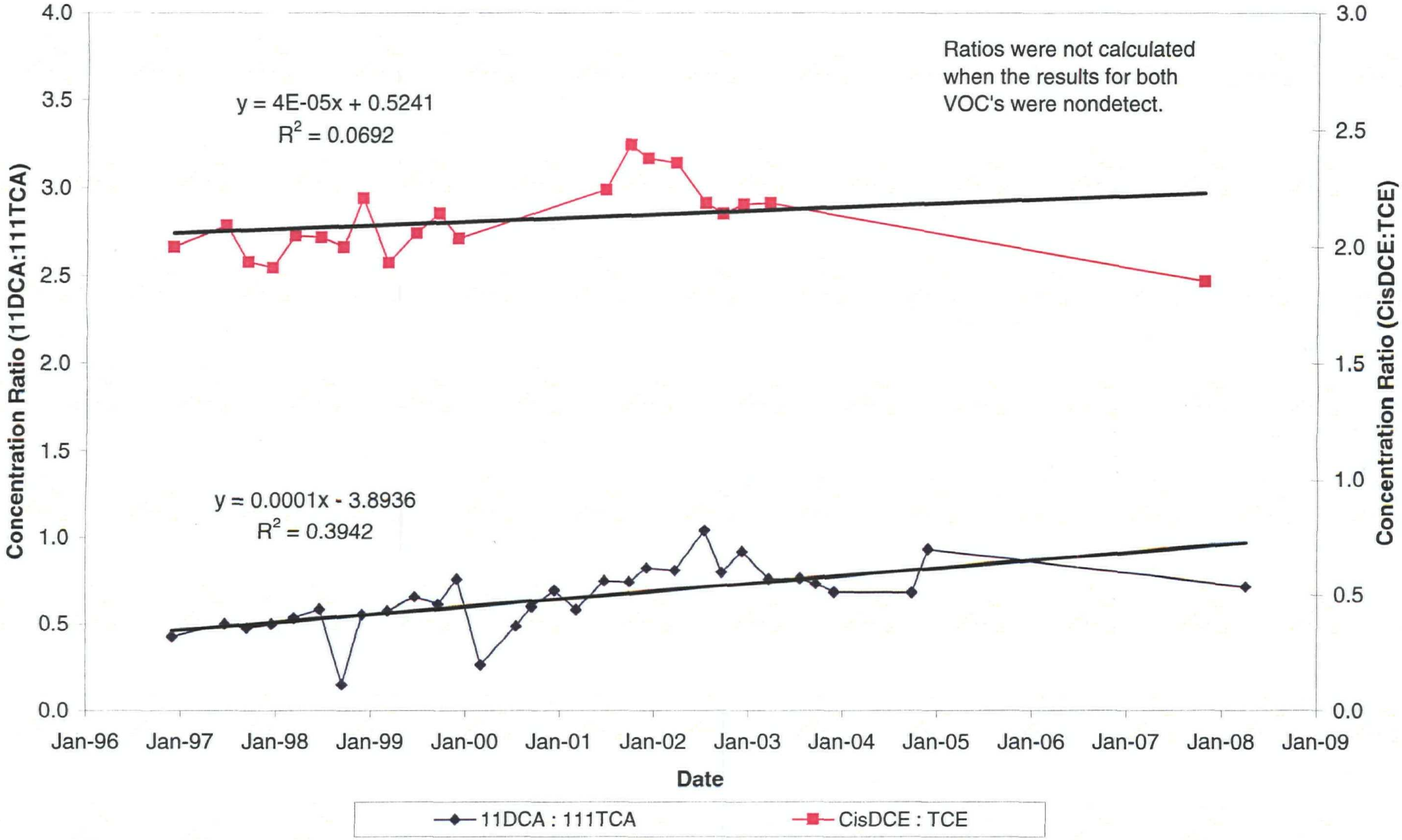
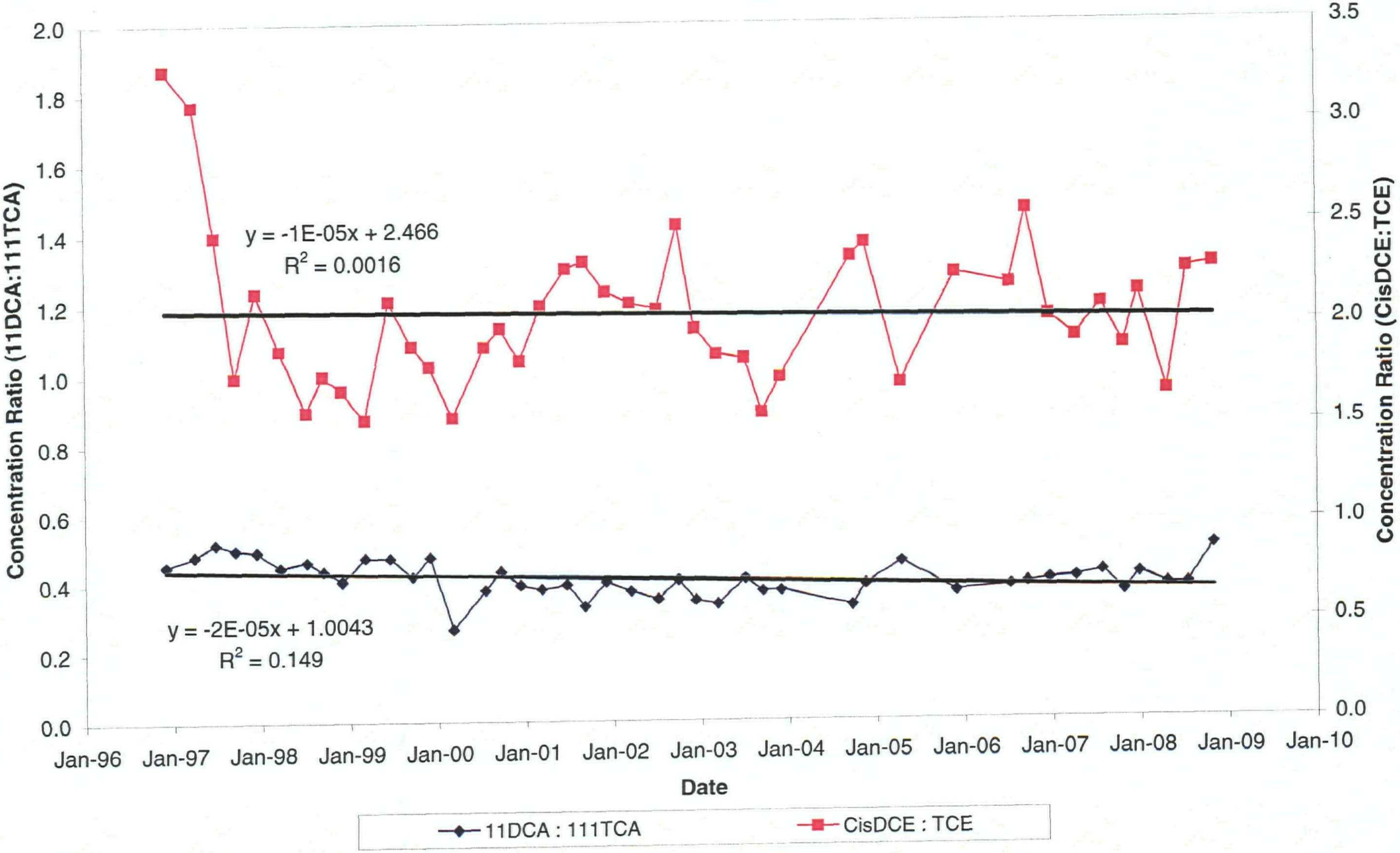
RM-002I
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



RM-003D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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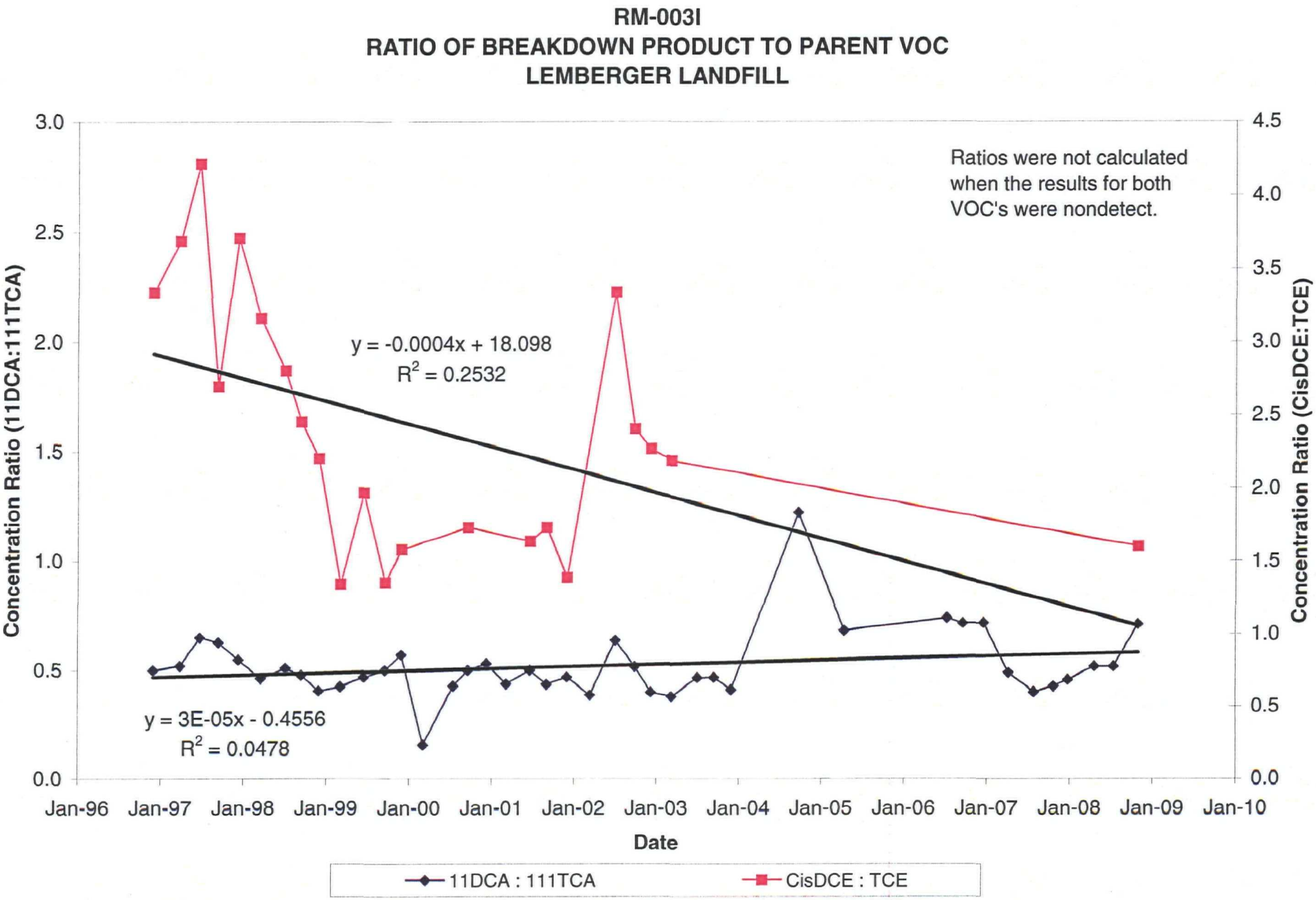

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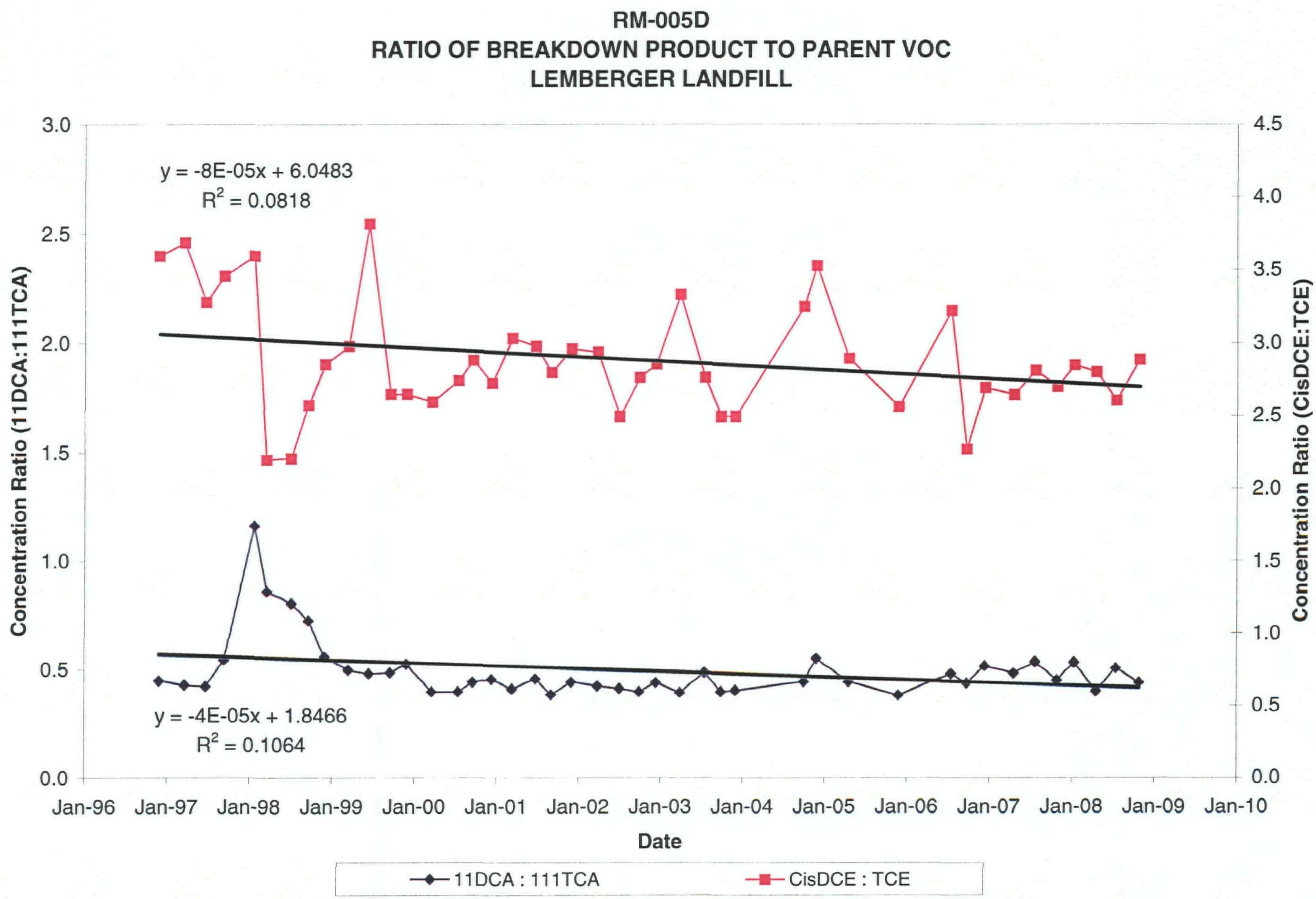

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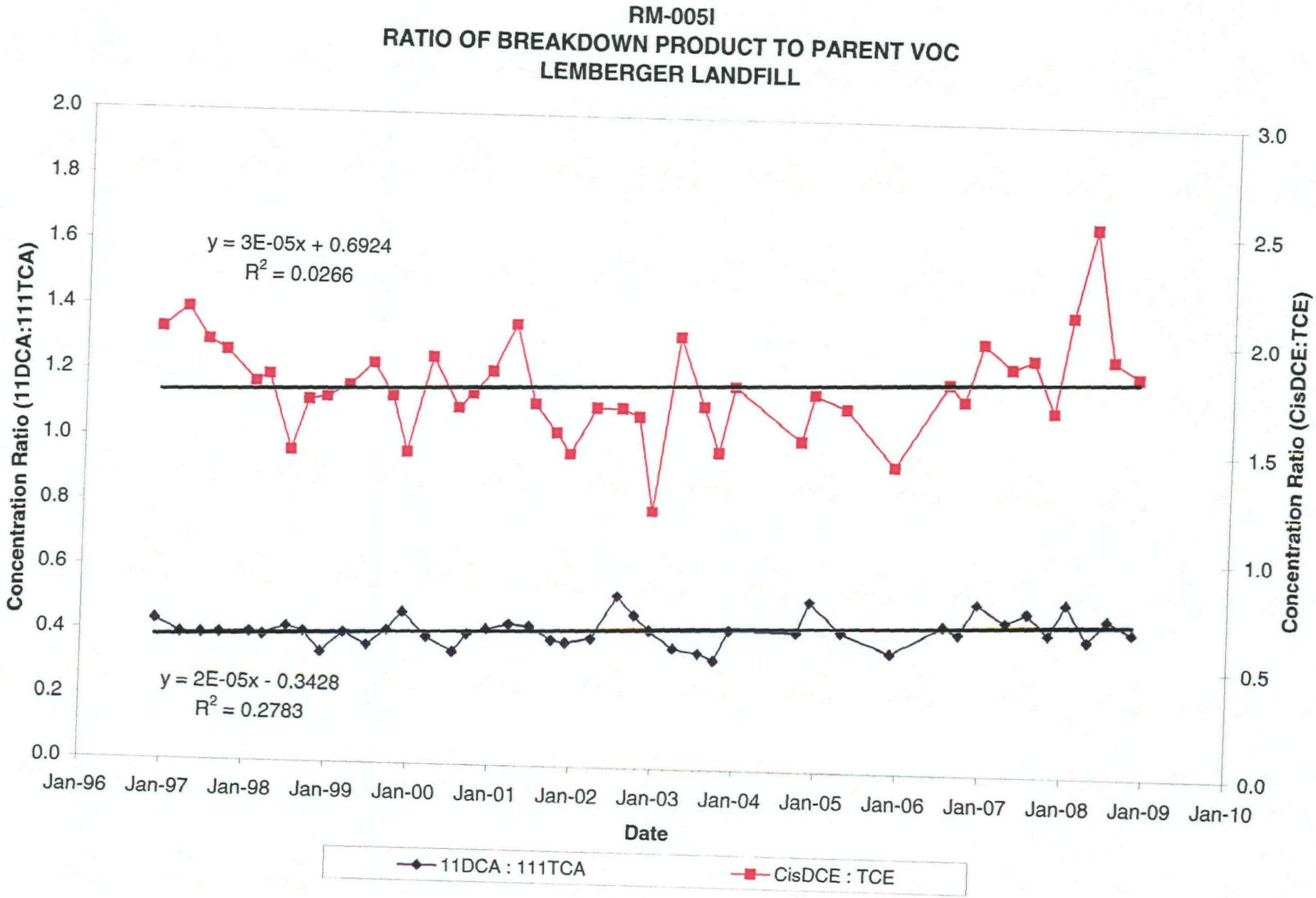

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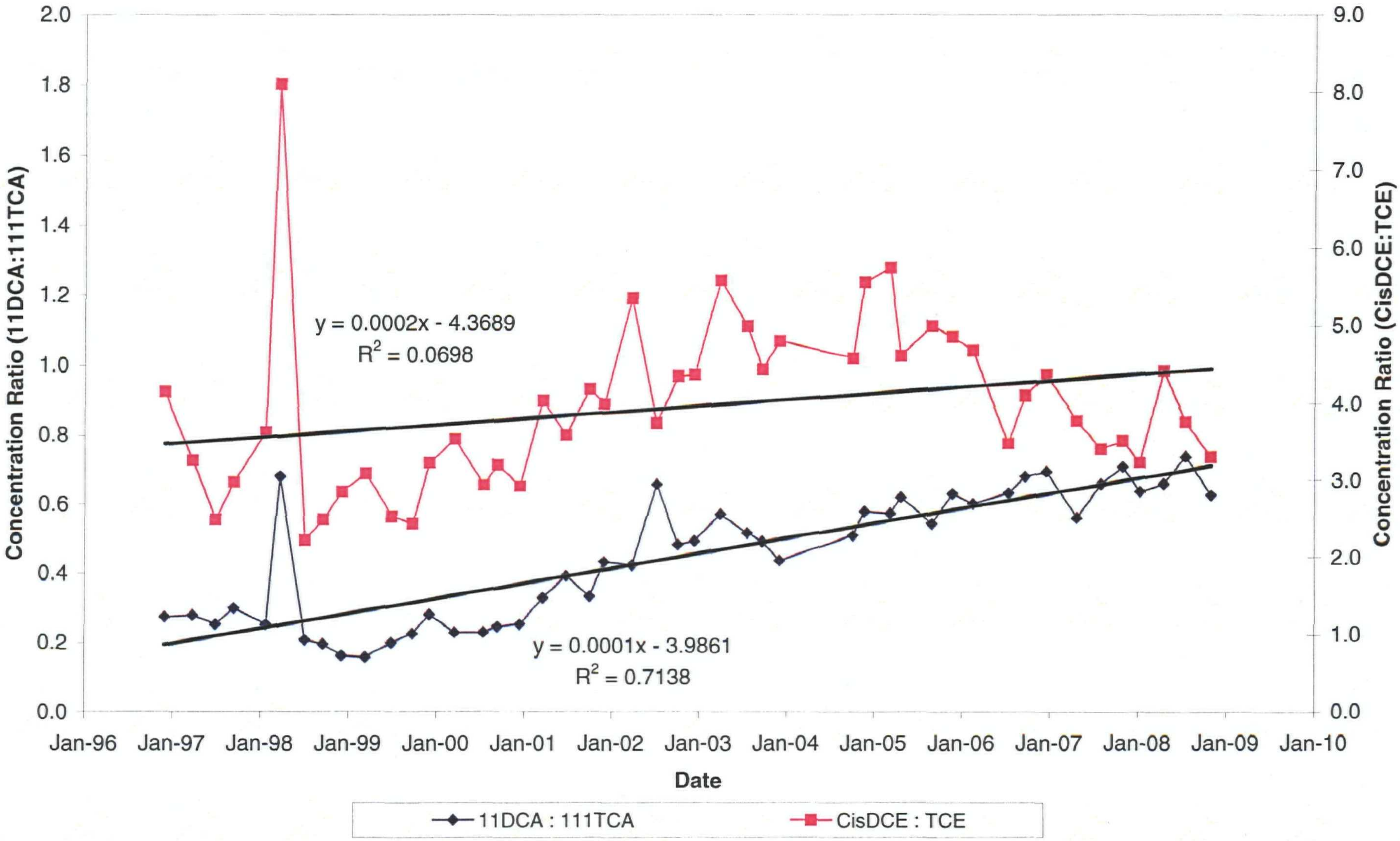
RM-007D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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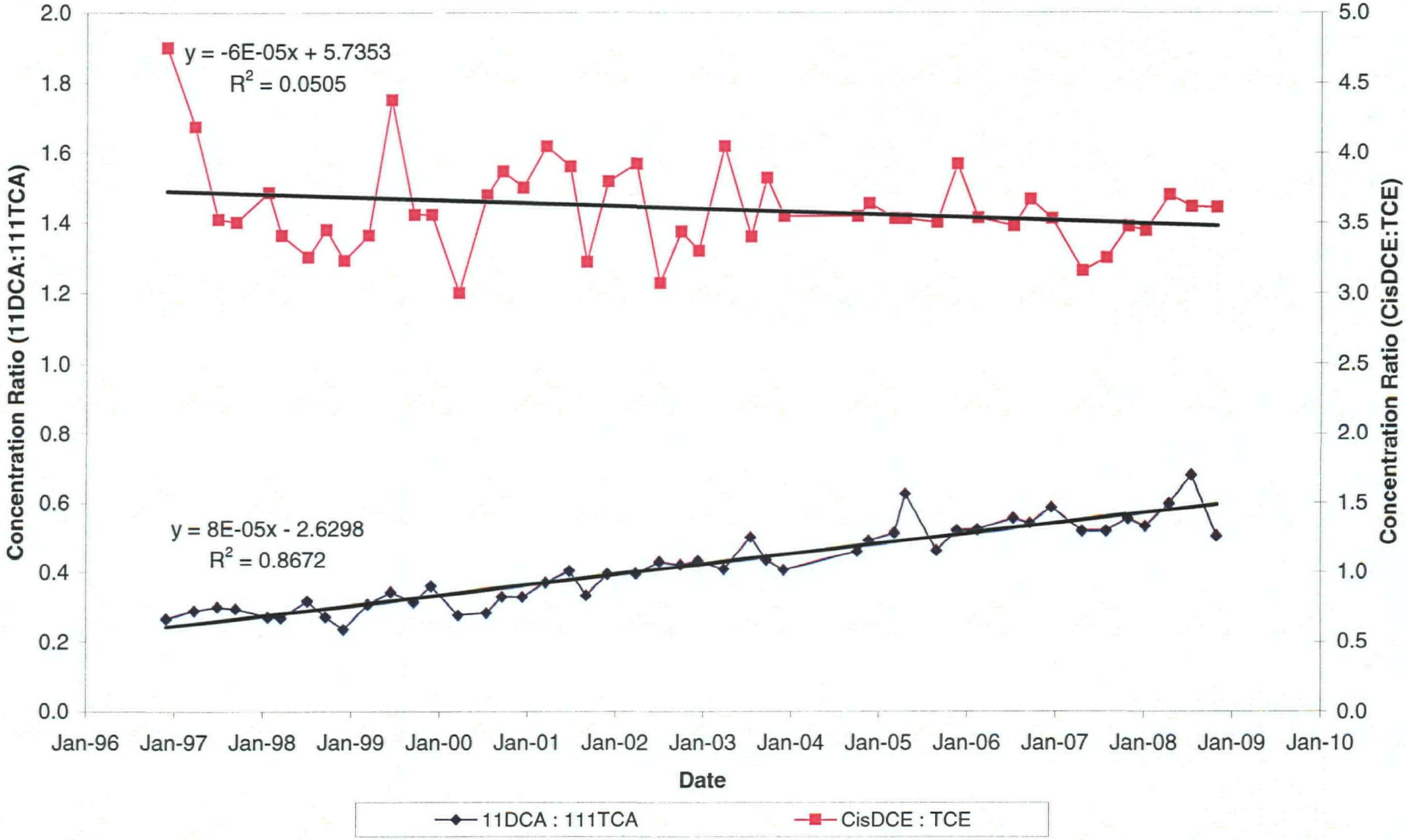
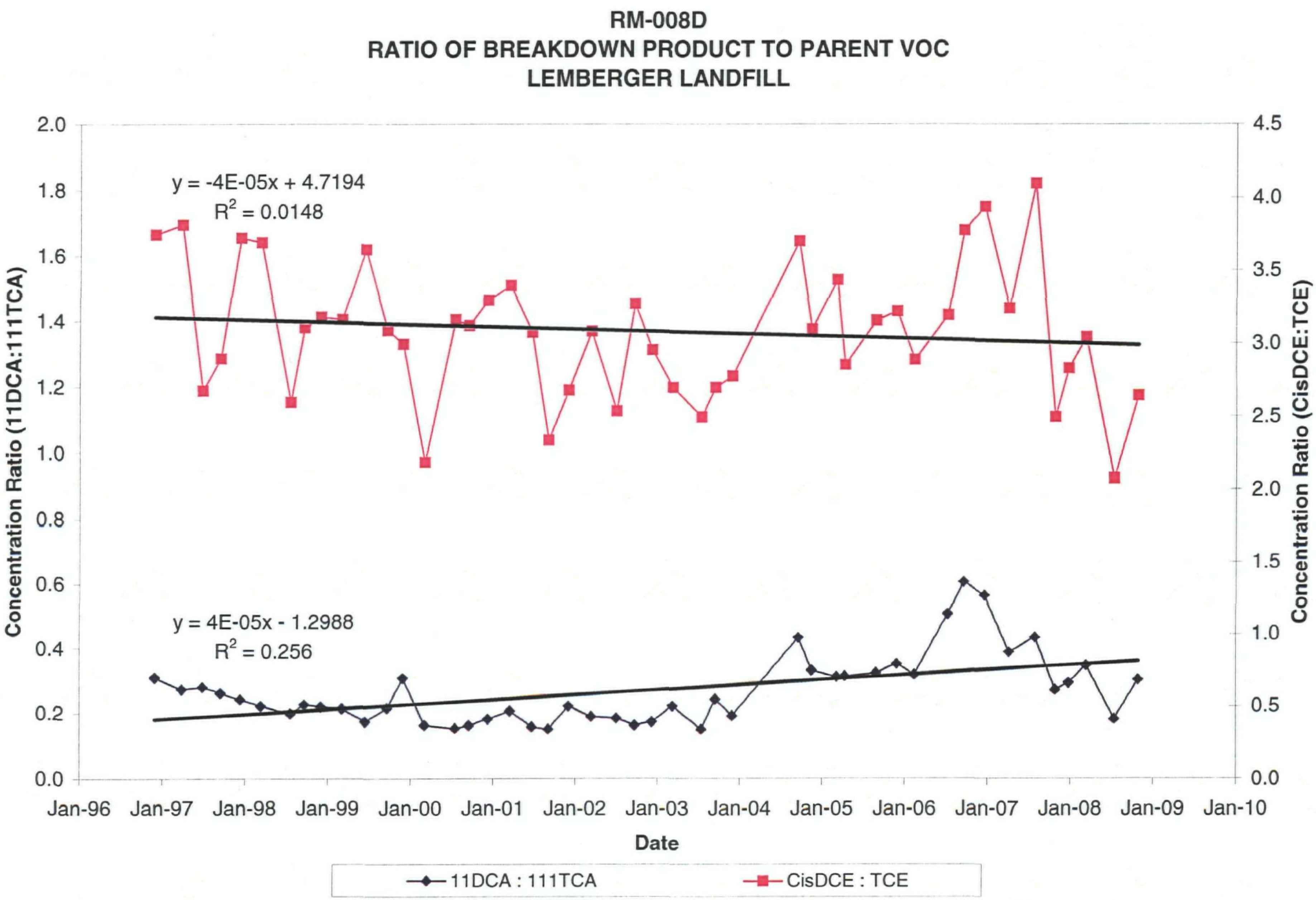
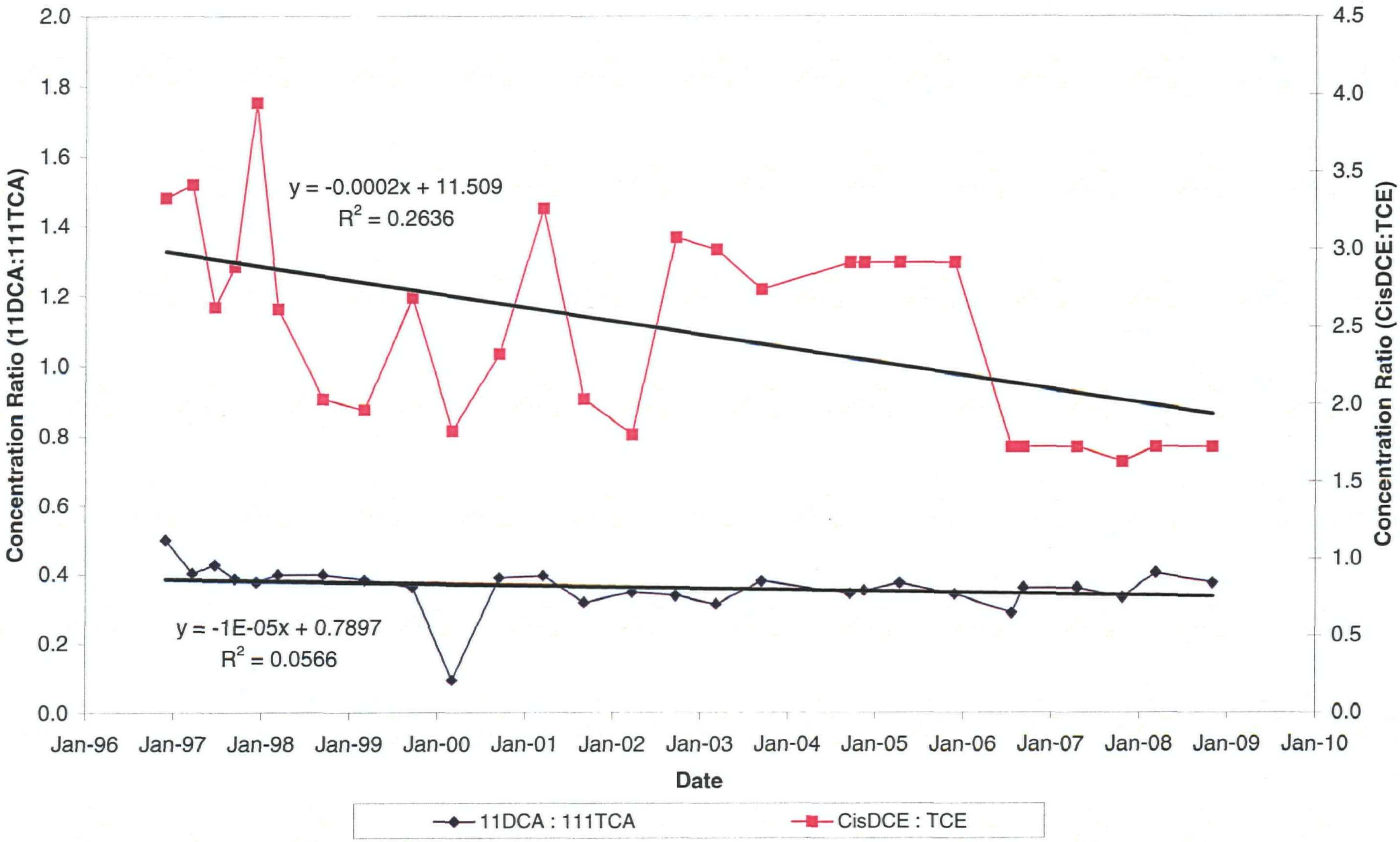
RM-007XD
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL





RM-008D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL
y = -4E-05x + 4.7194
R^2 = 0.0148
y = 4E-05x - 1.2988
R^2 = 0.256
Concentration Ratio (11DCA:111TCA)
Concentration Ratio (CisDCE:TCE)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date
11DCA : 111TCA
CisDCE : TCE

RM-010D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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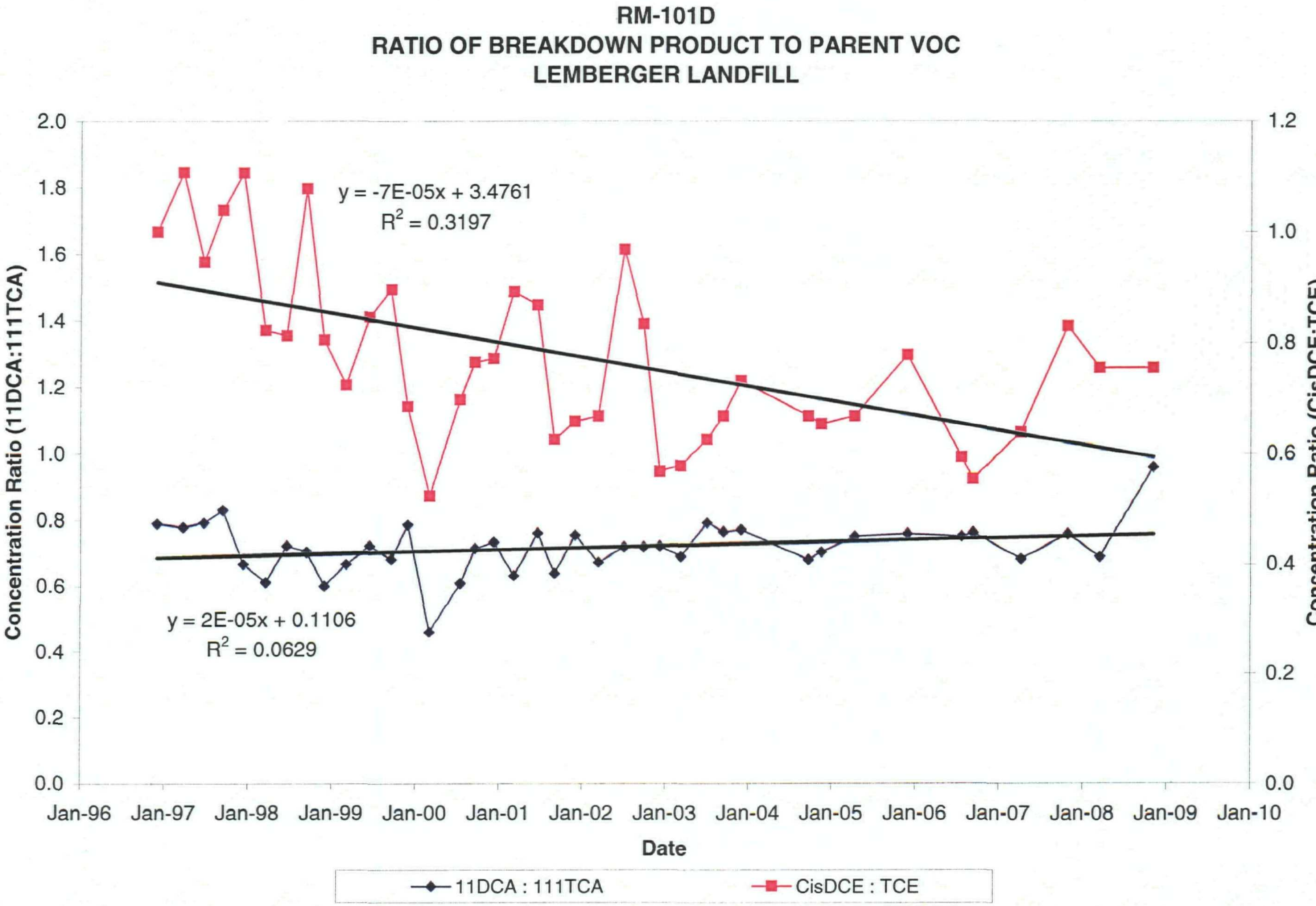
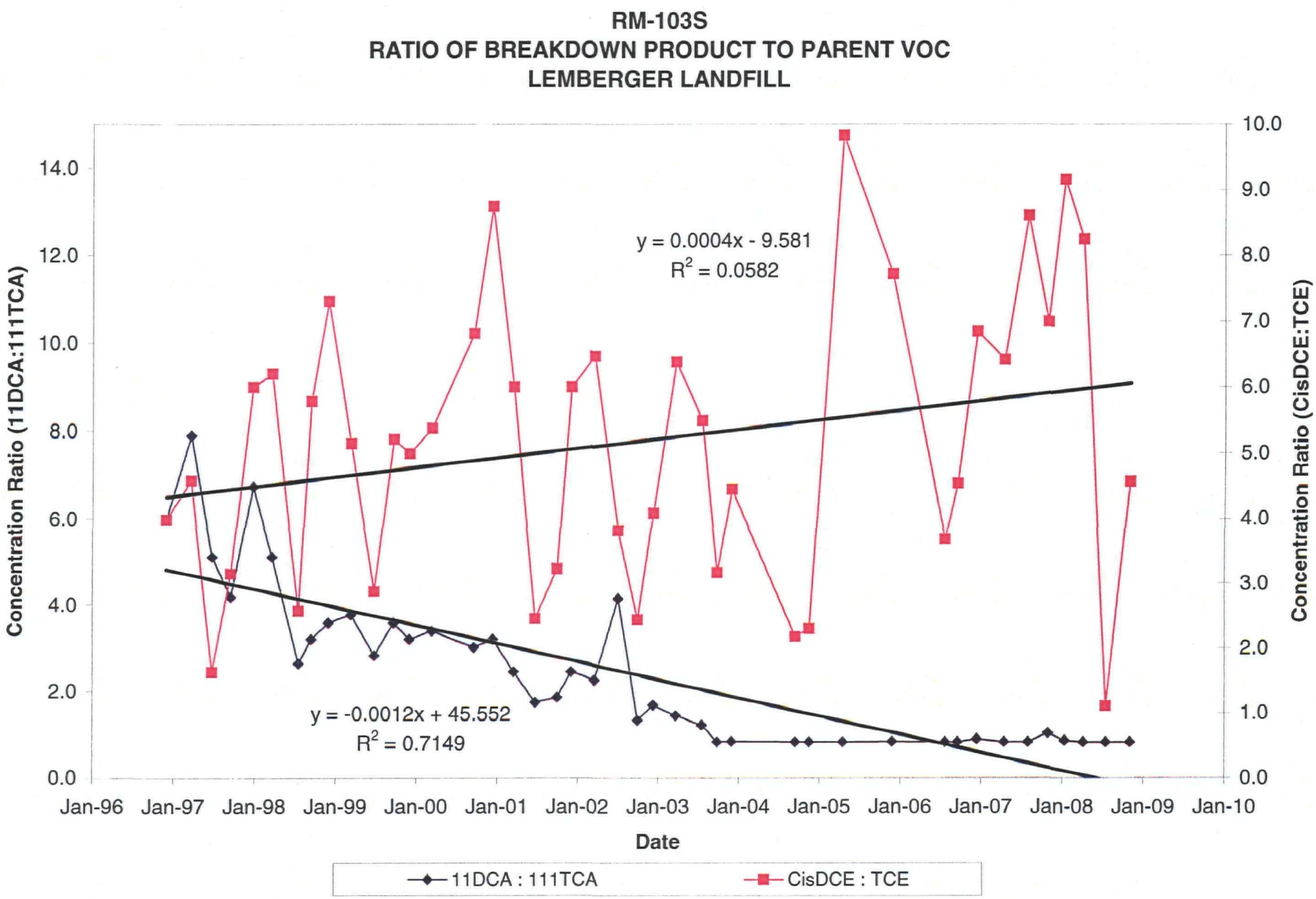
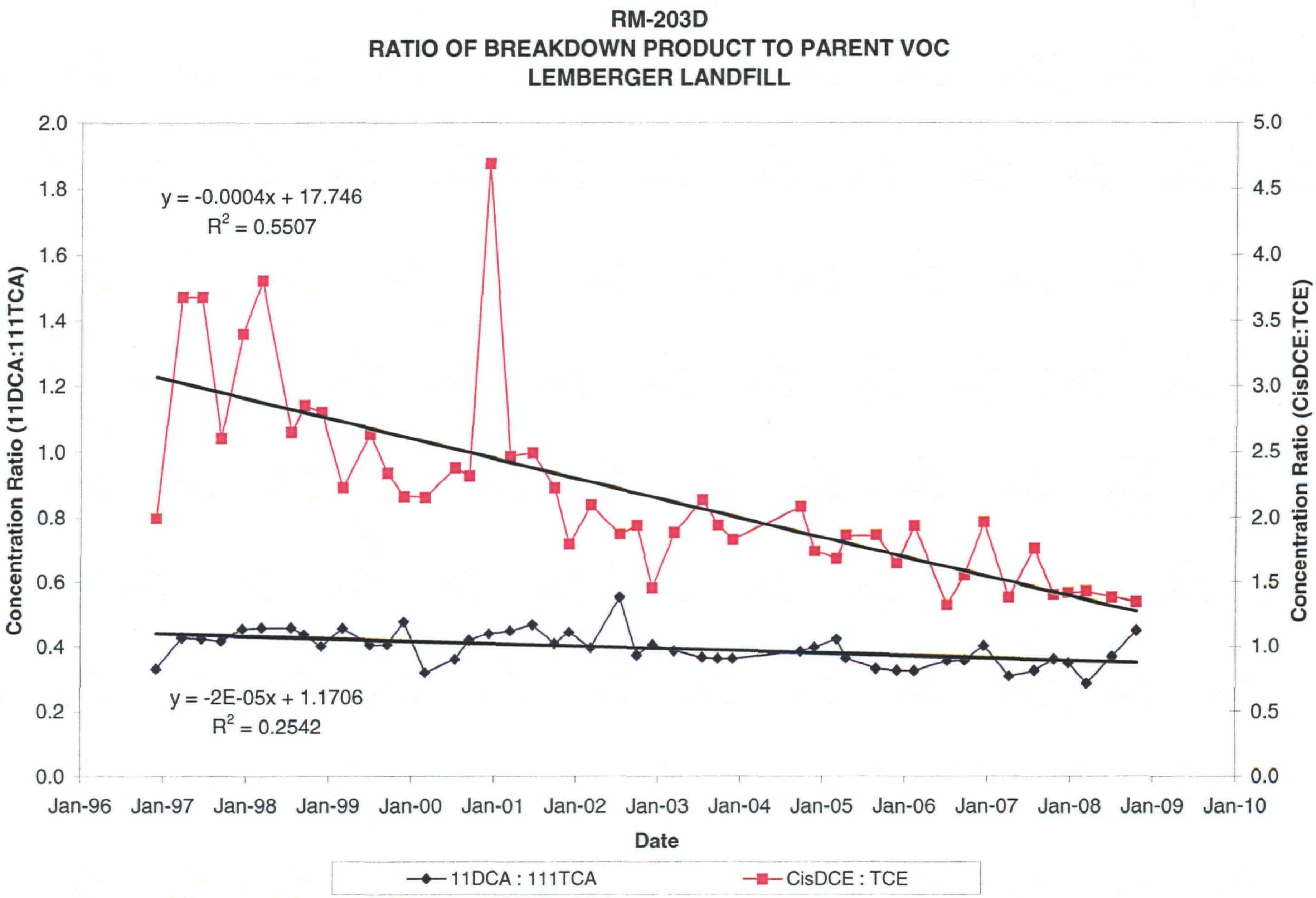


I:\WPMSN\PJT\00-03458\40\000345840-002.XLS 4/17/2009

RM-103D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL


RM-103S
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL
y = 0.0004x - 9.581
R2 = 0.0582
y = -0.0012x + 45.552
R2 = 0.7149
Concentration Ratio (11DCA:111TCA)
Concentration Ratio (CisDCE:TCE)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
1.0
3.0
5.0
7.0
9.0
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date
11DCA : 111TCA
CisDCE : TCE



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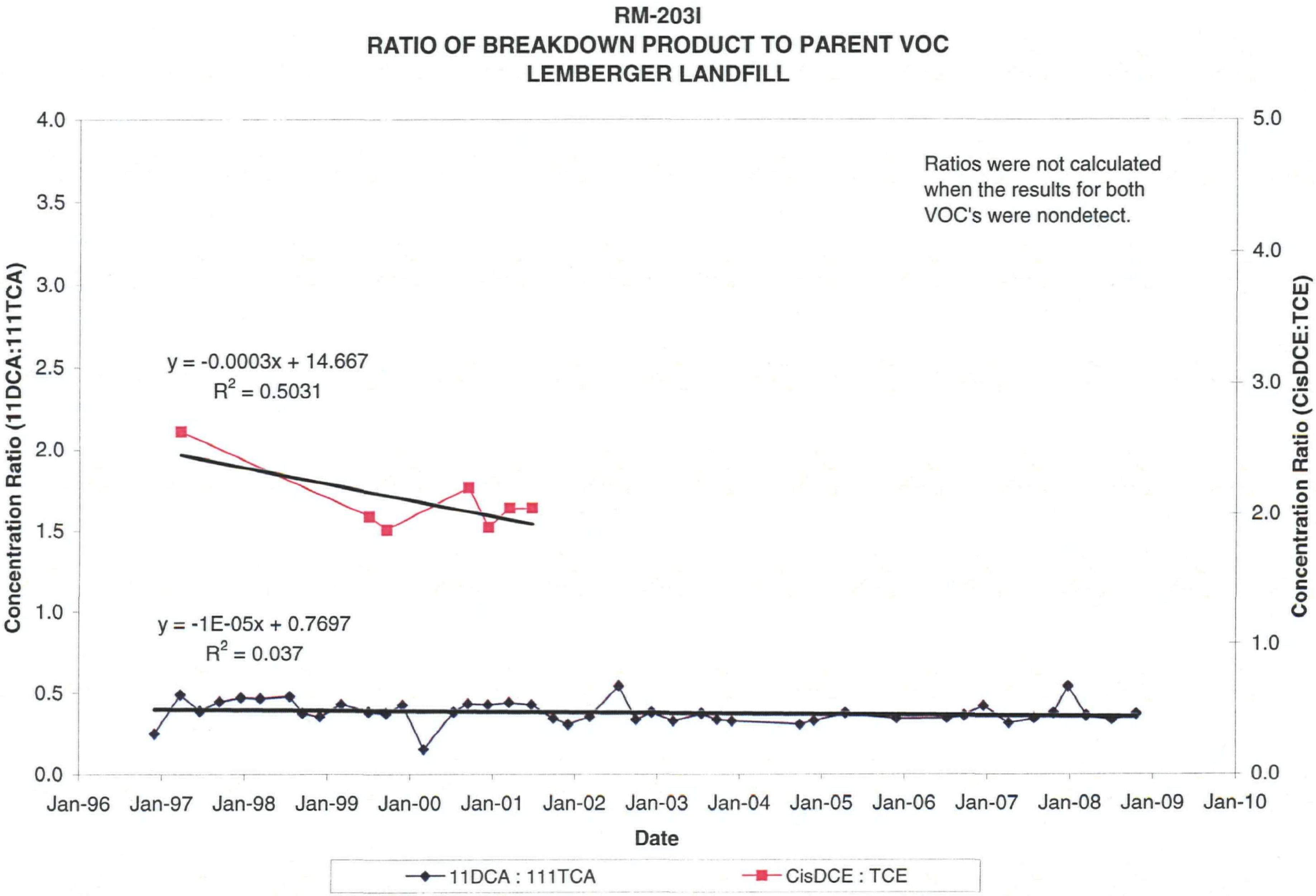

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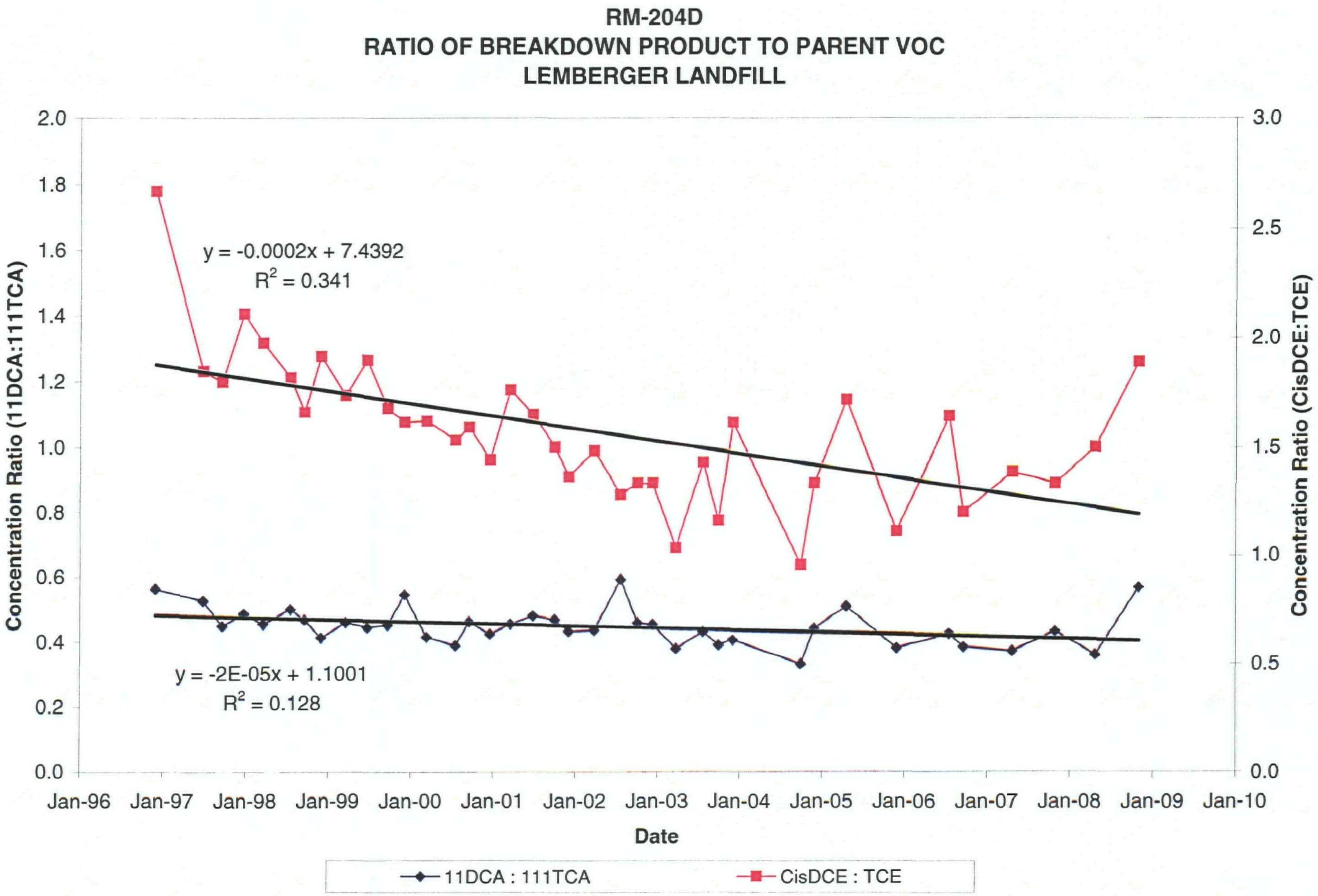

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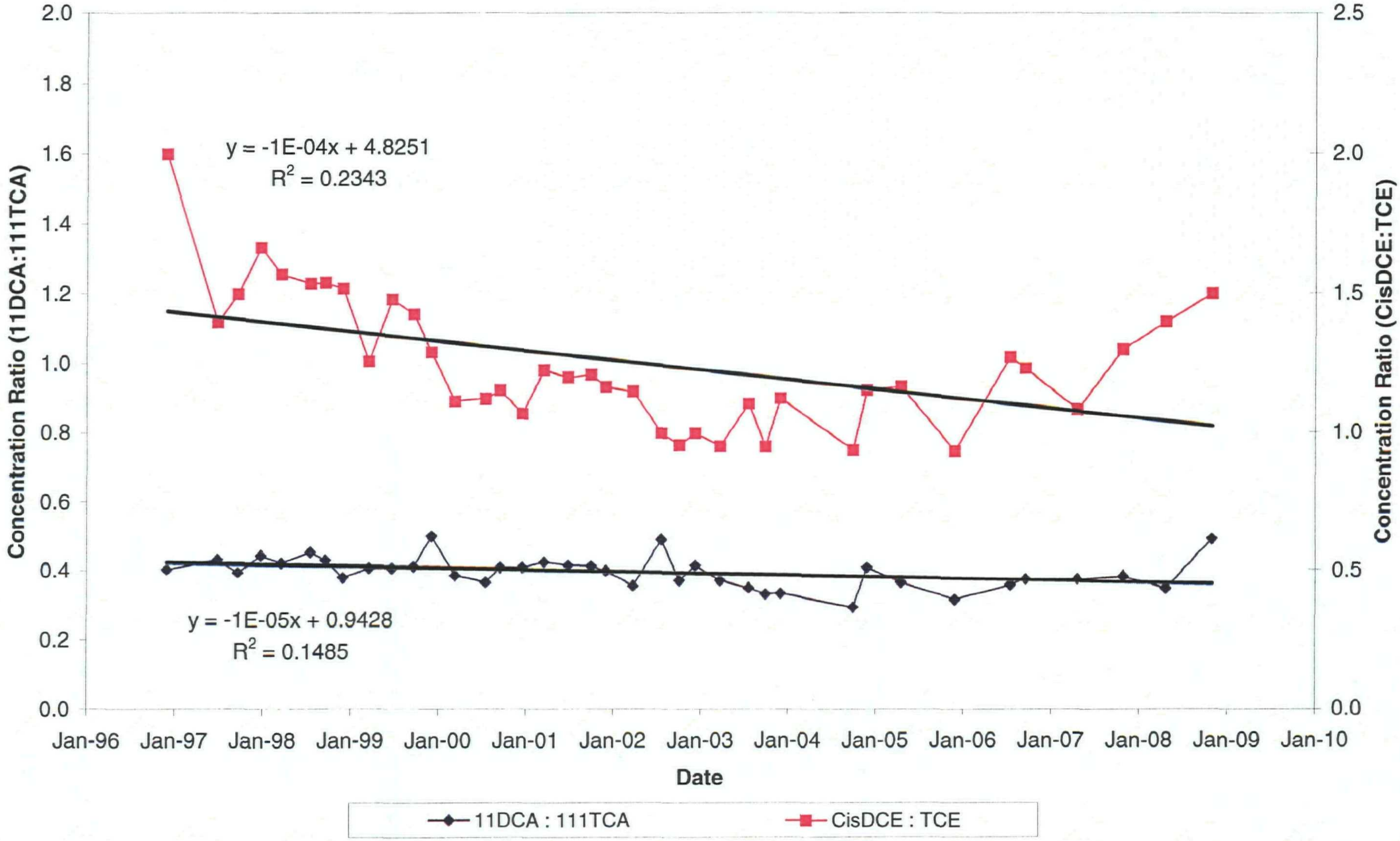
RM-204I
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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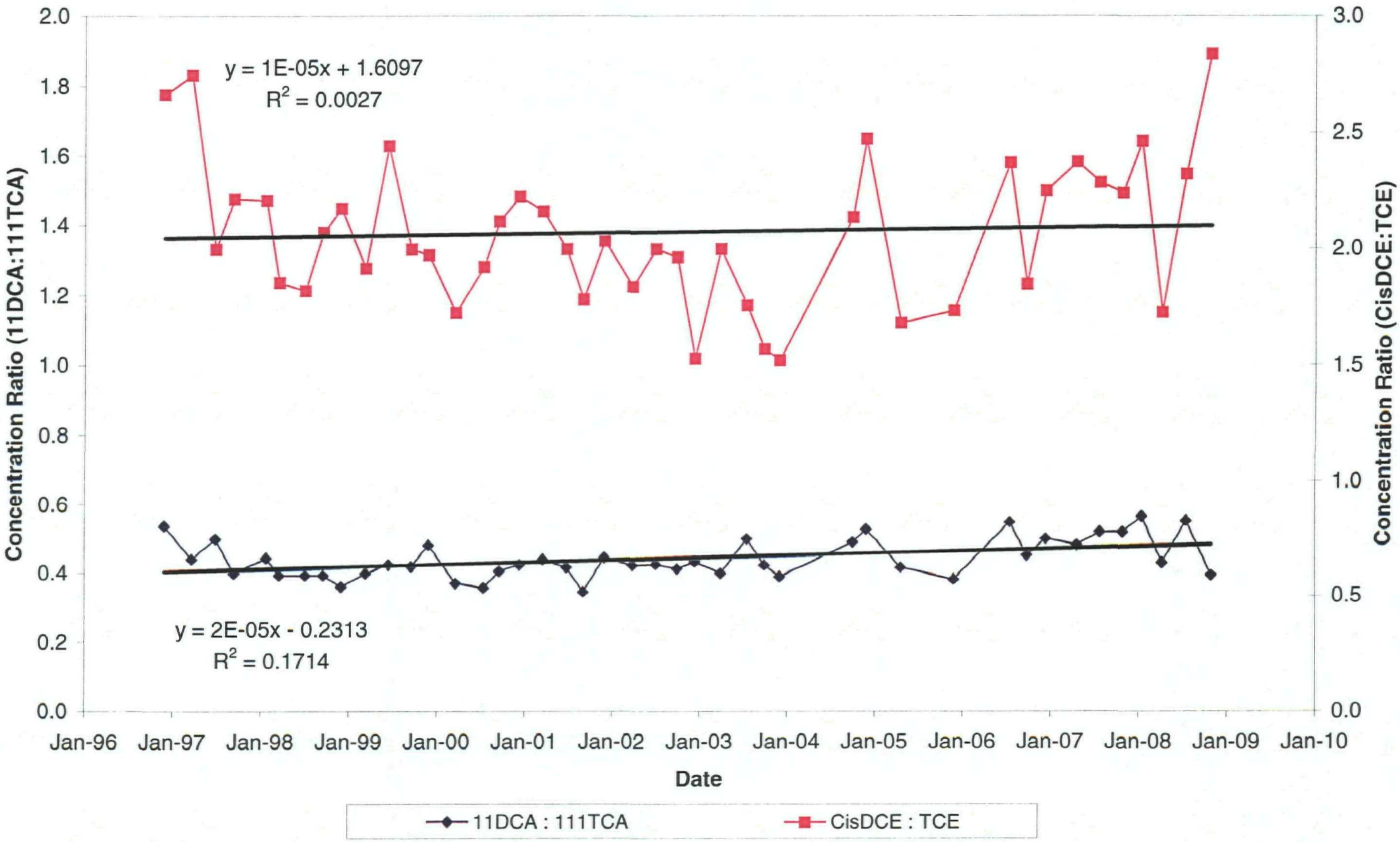
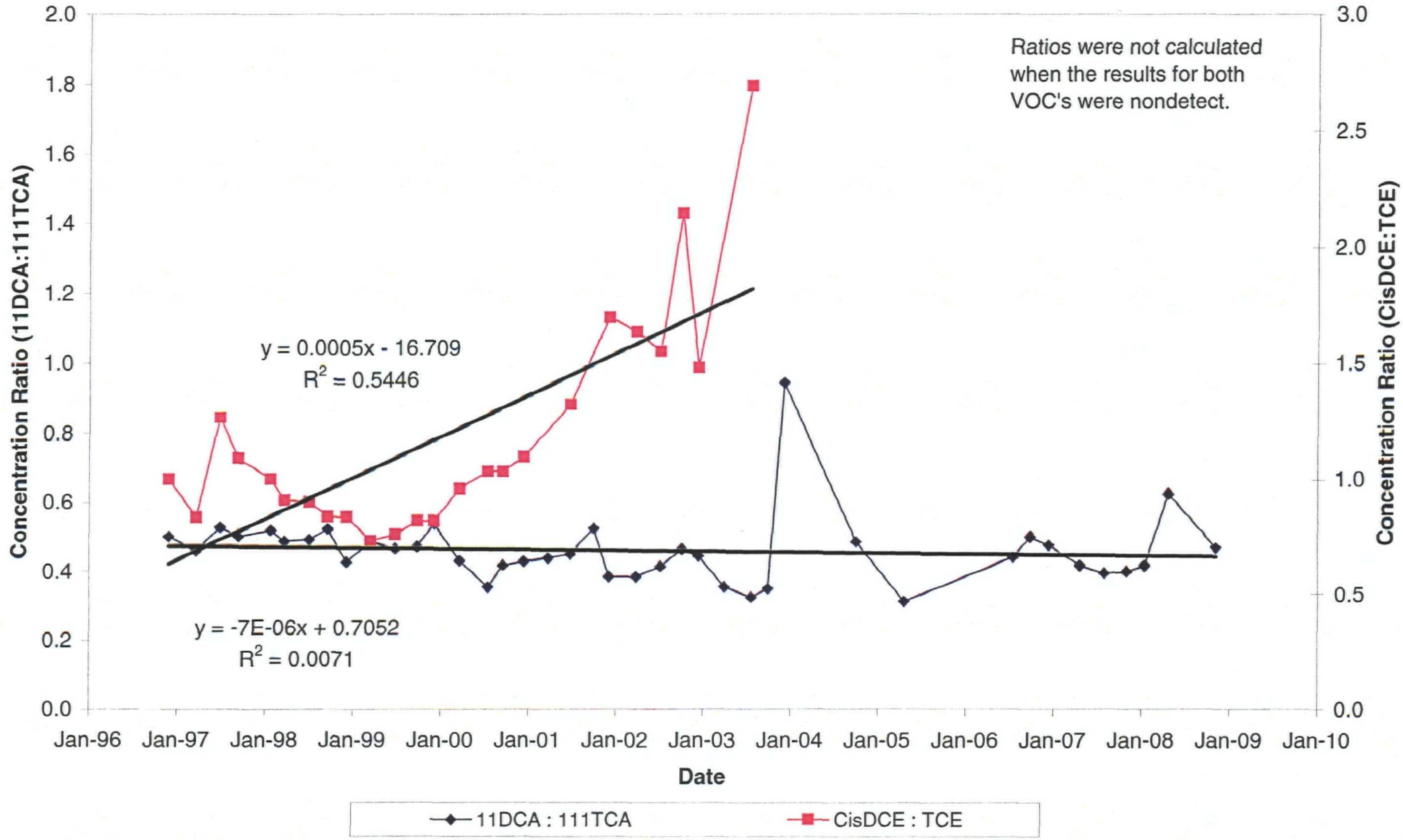
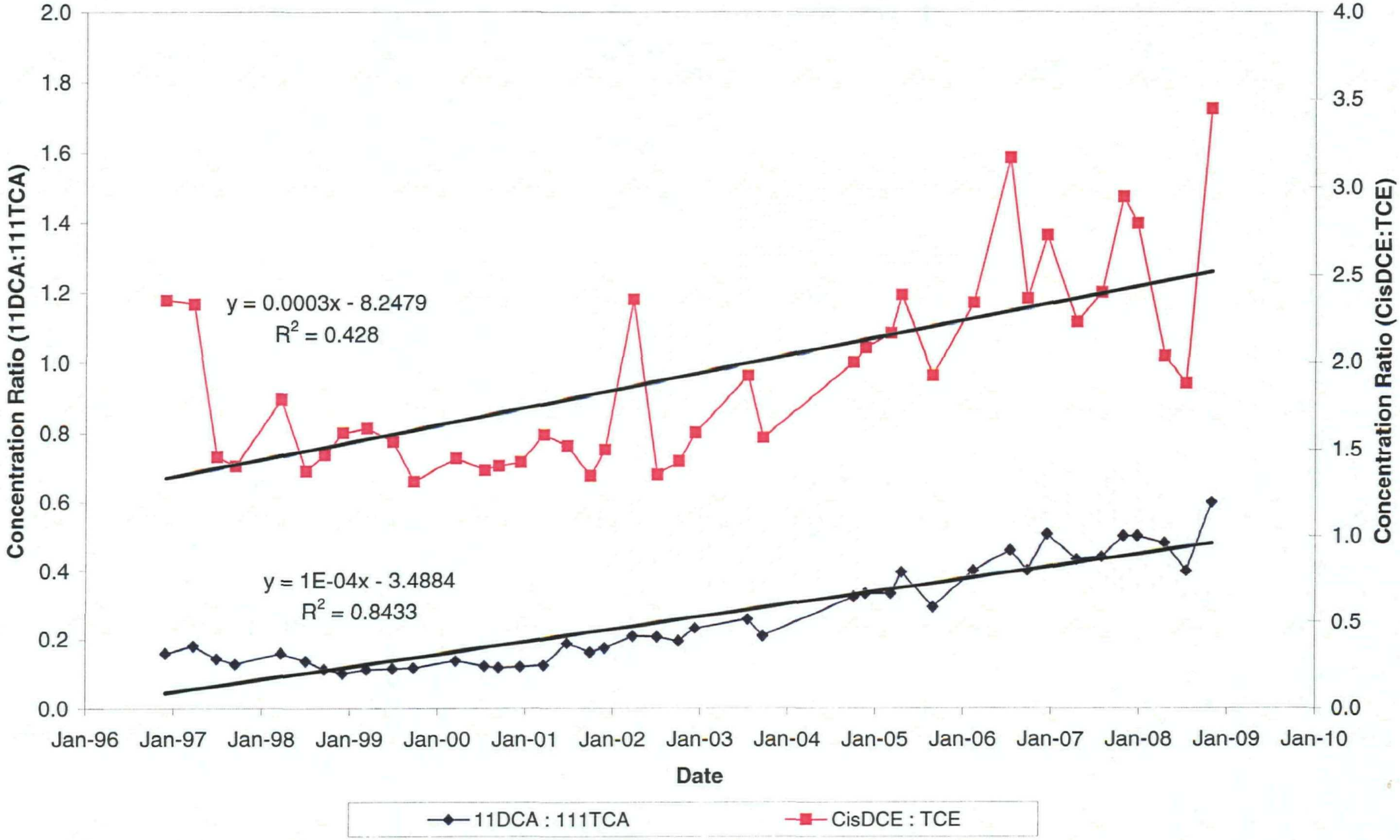
RM-208D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL

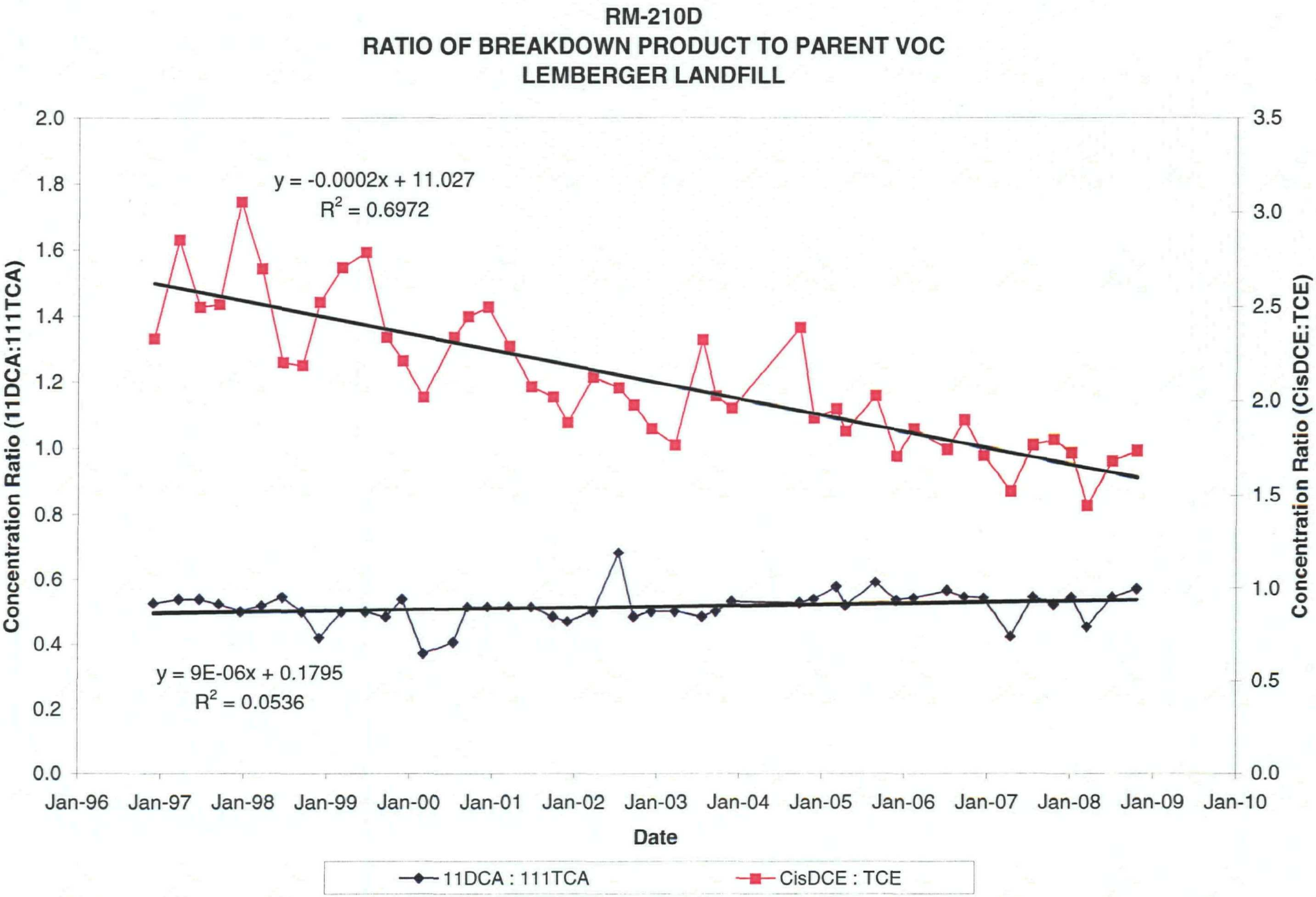


RM-208I
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



RM-209D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL





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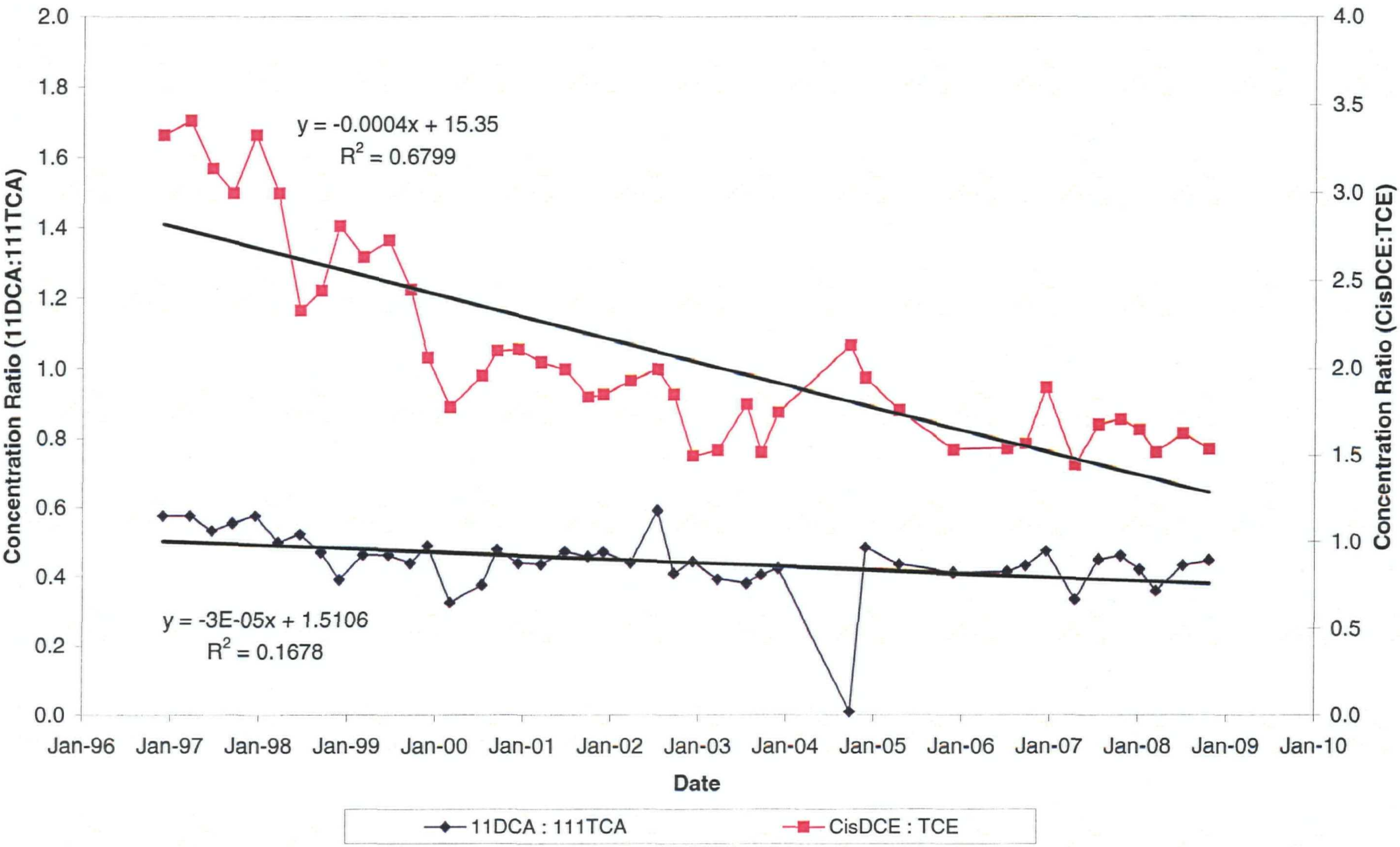
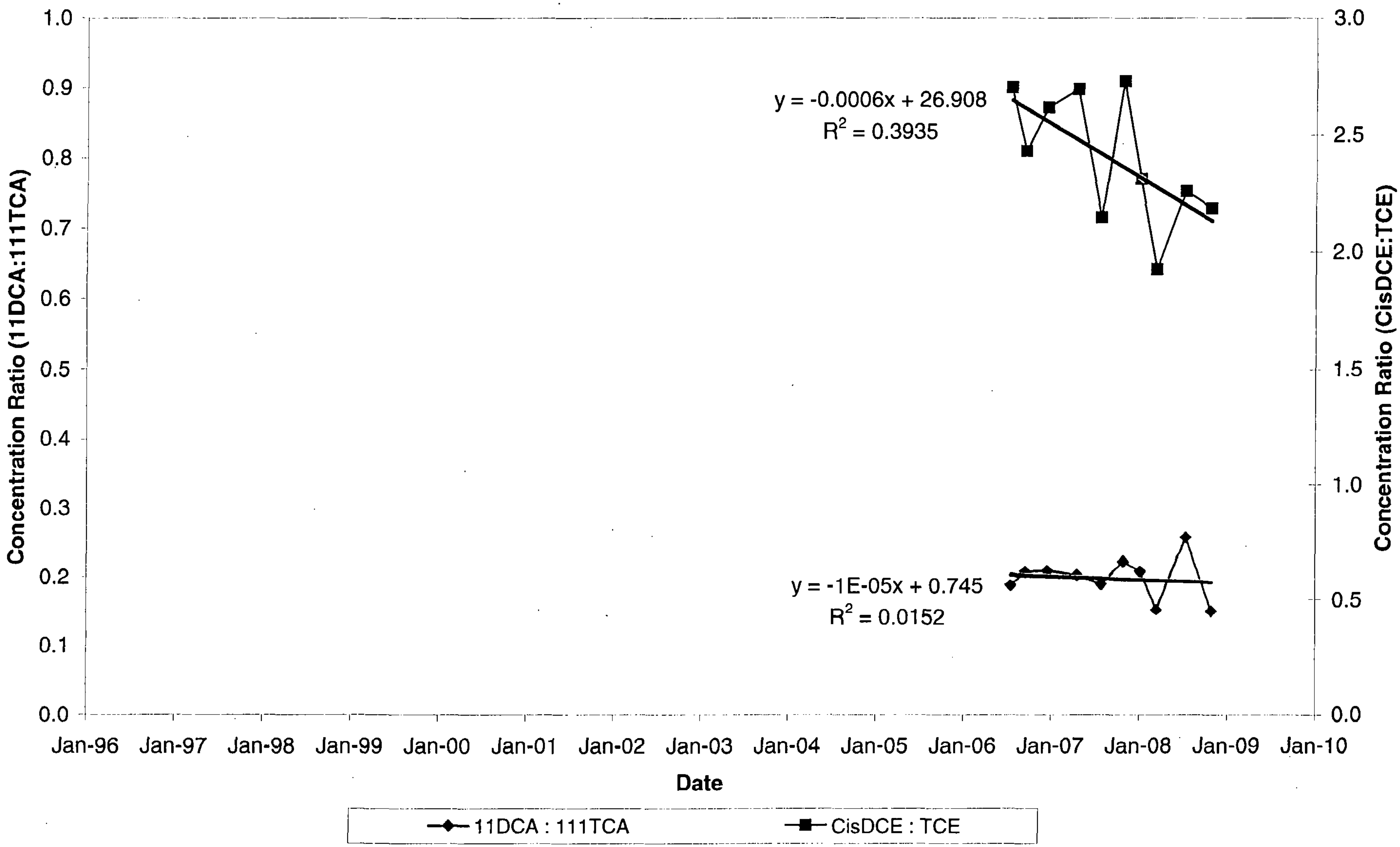
RM-210I
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



RM-213D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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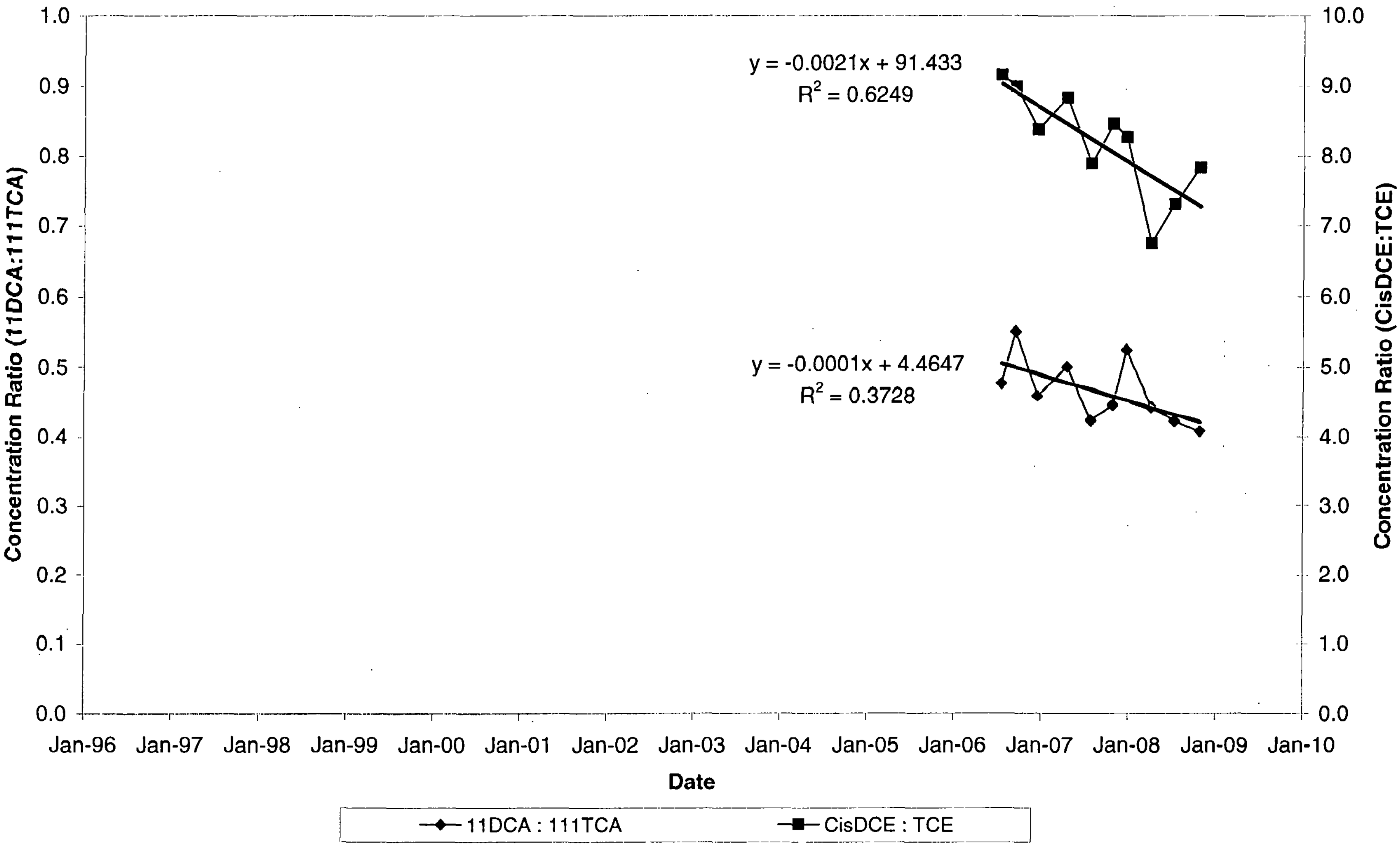
RM-214D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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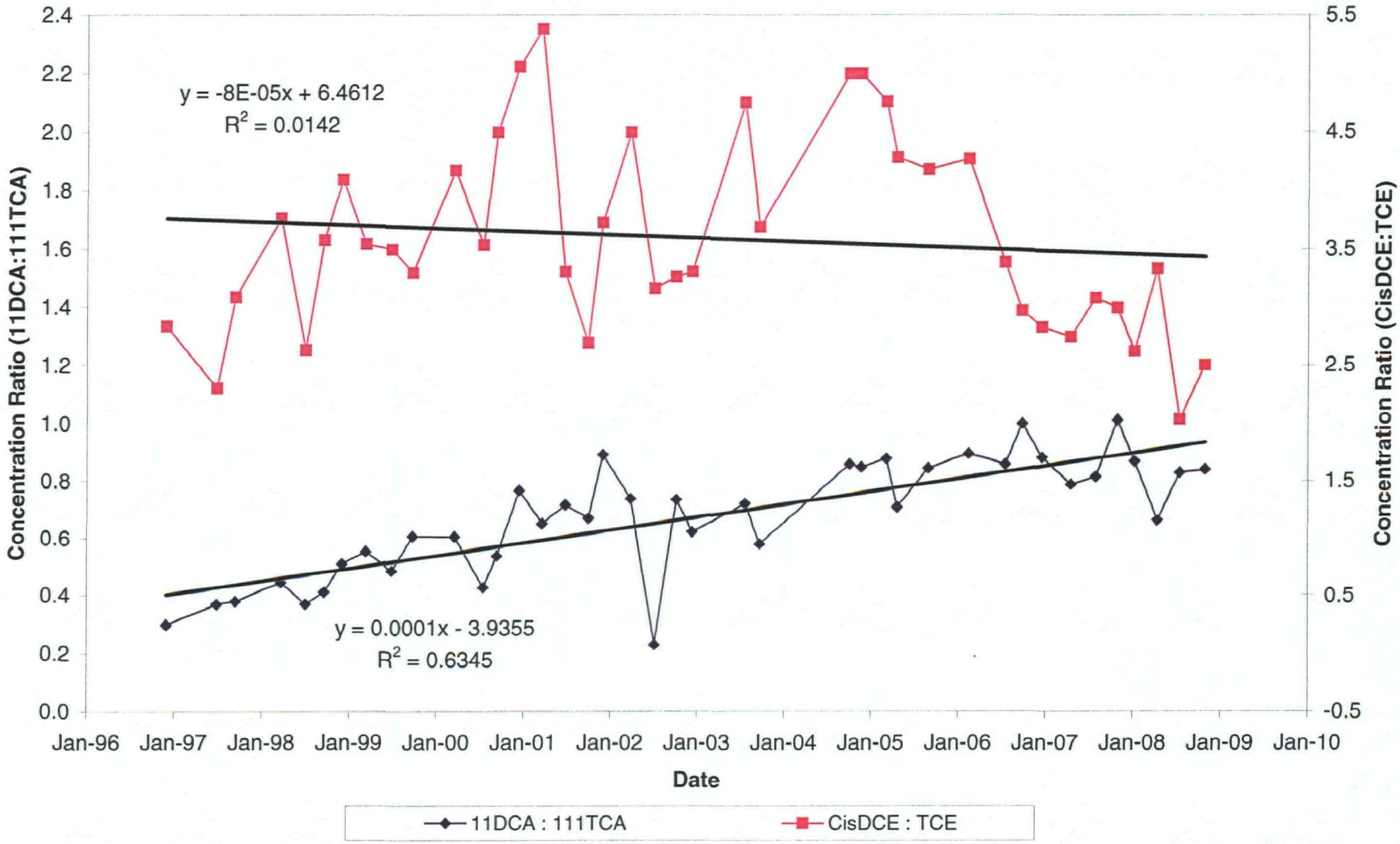
RM-303D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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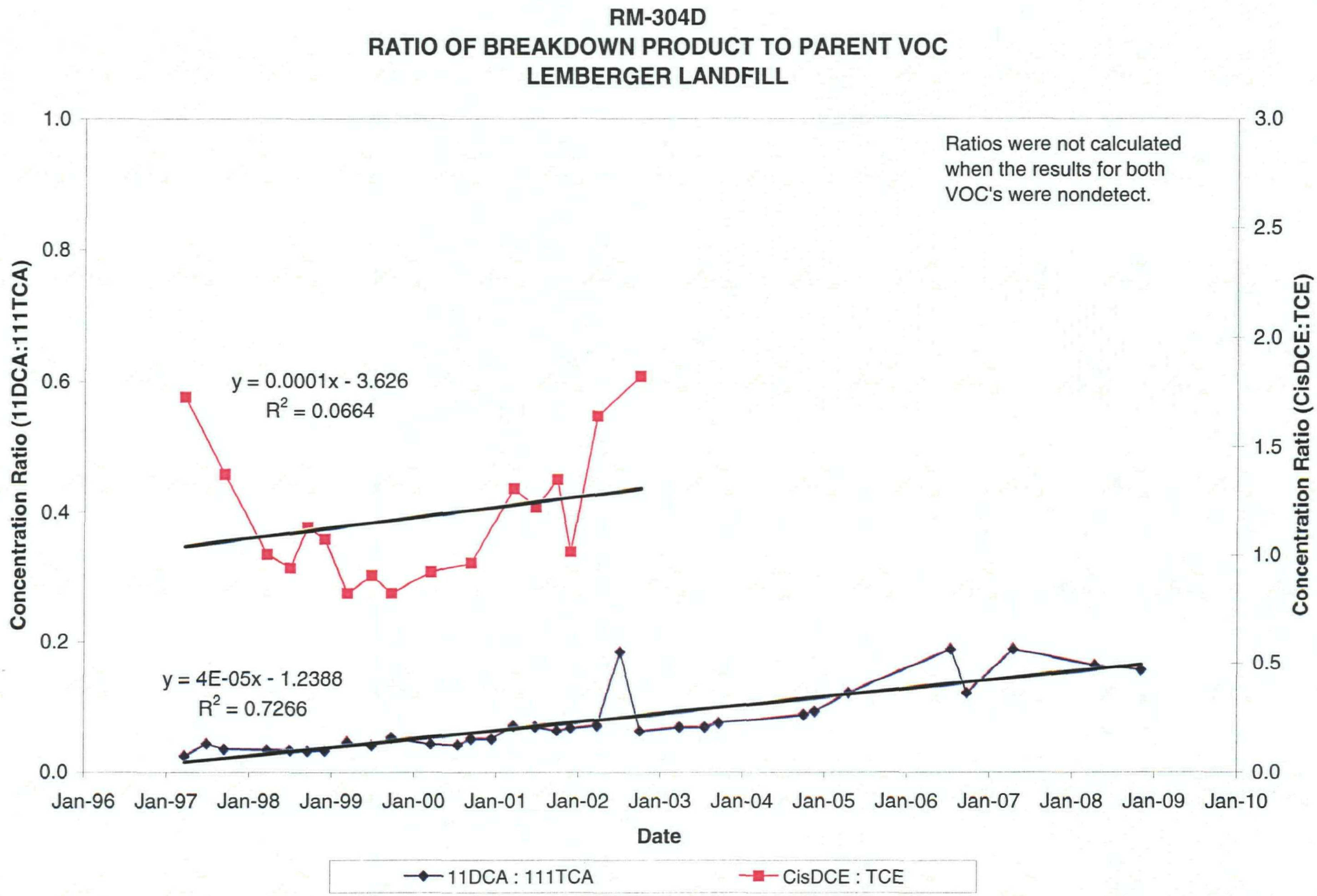

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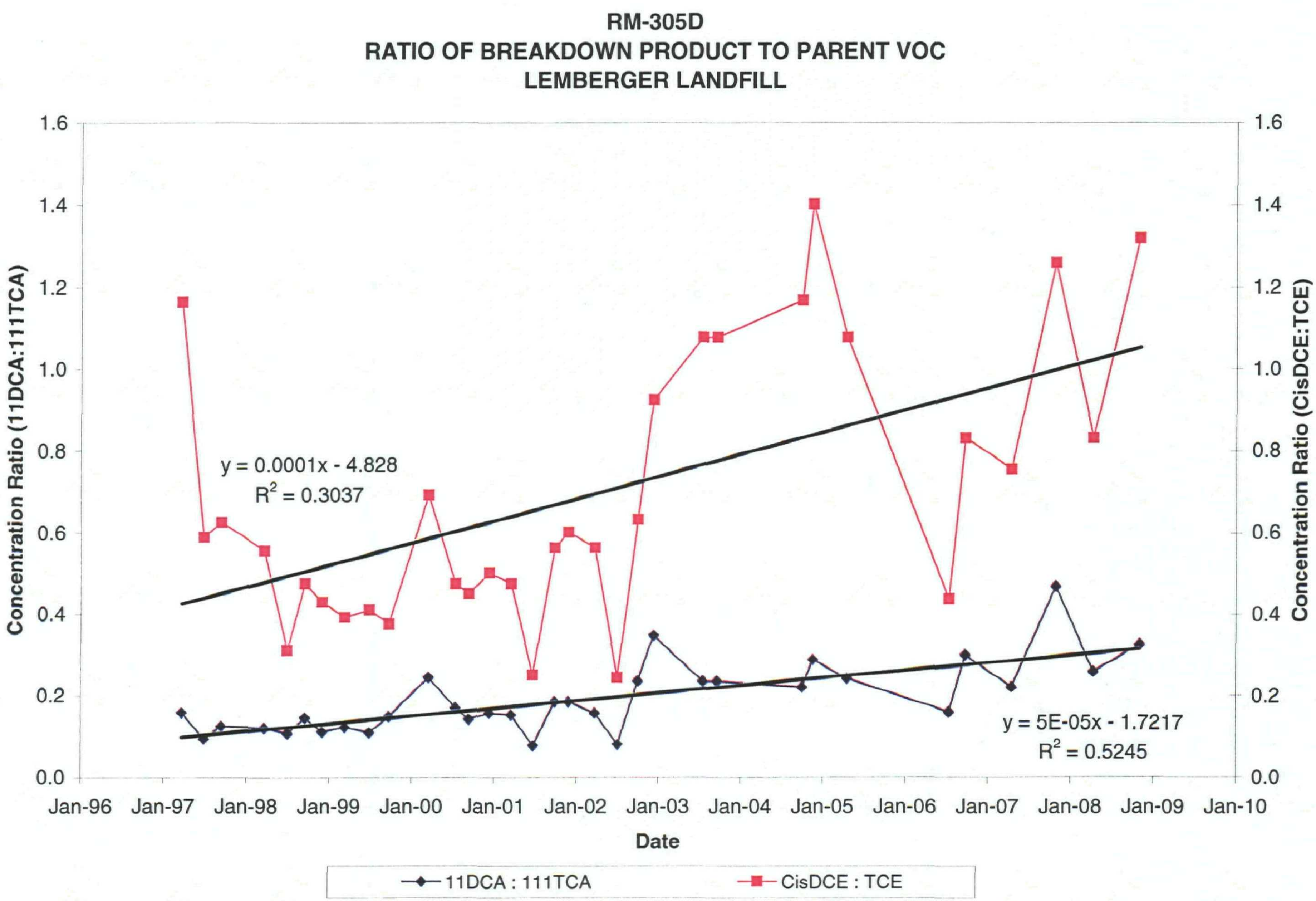

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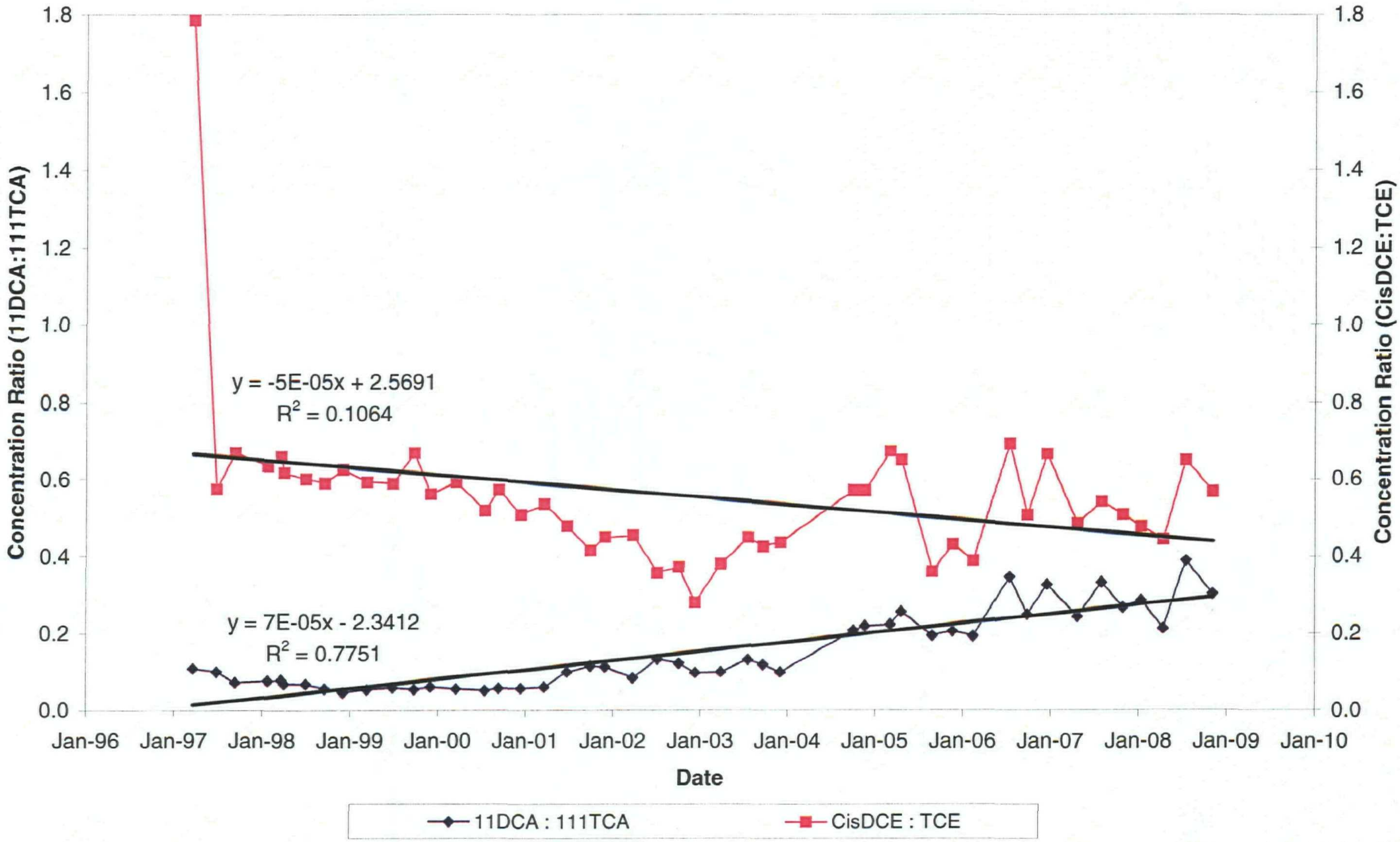
RM-306D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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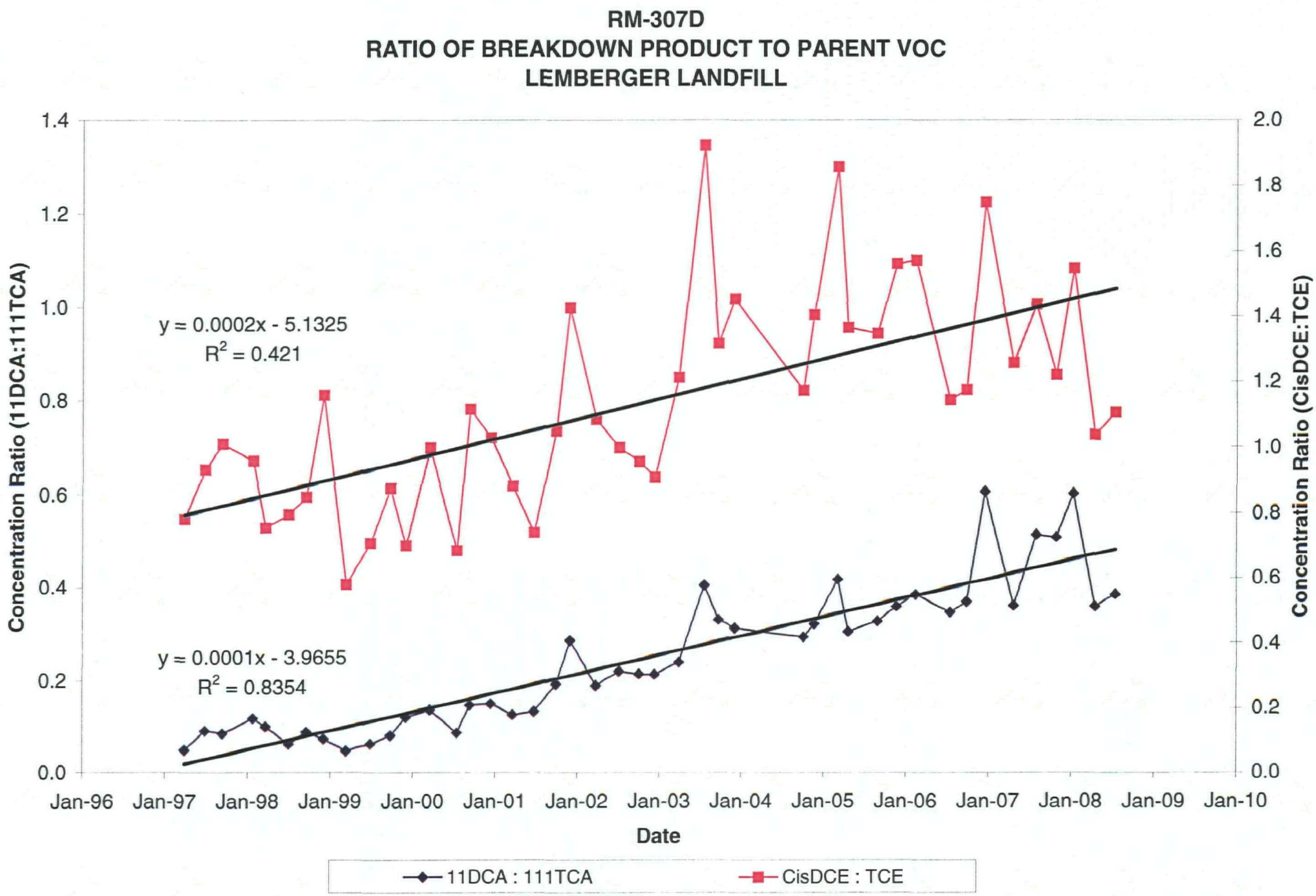
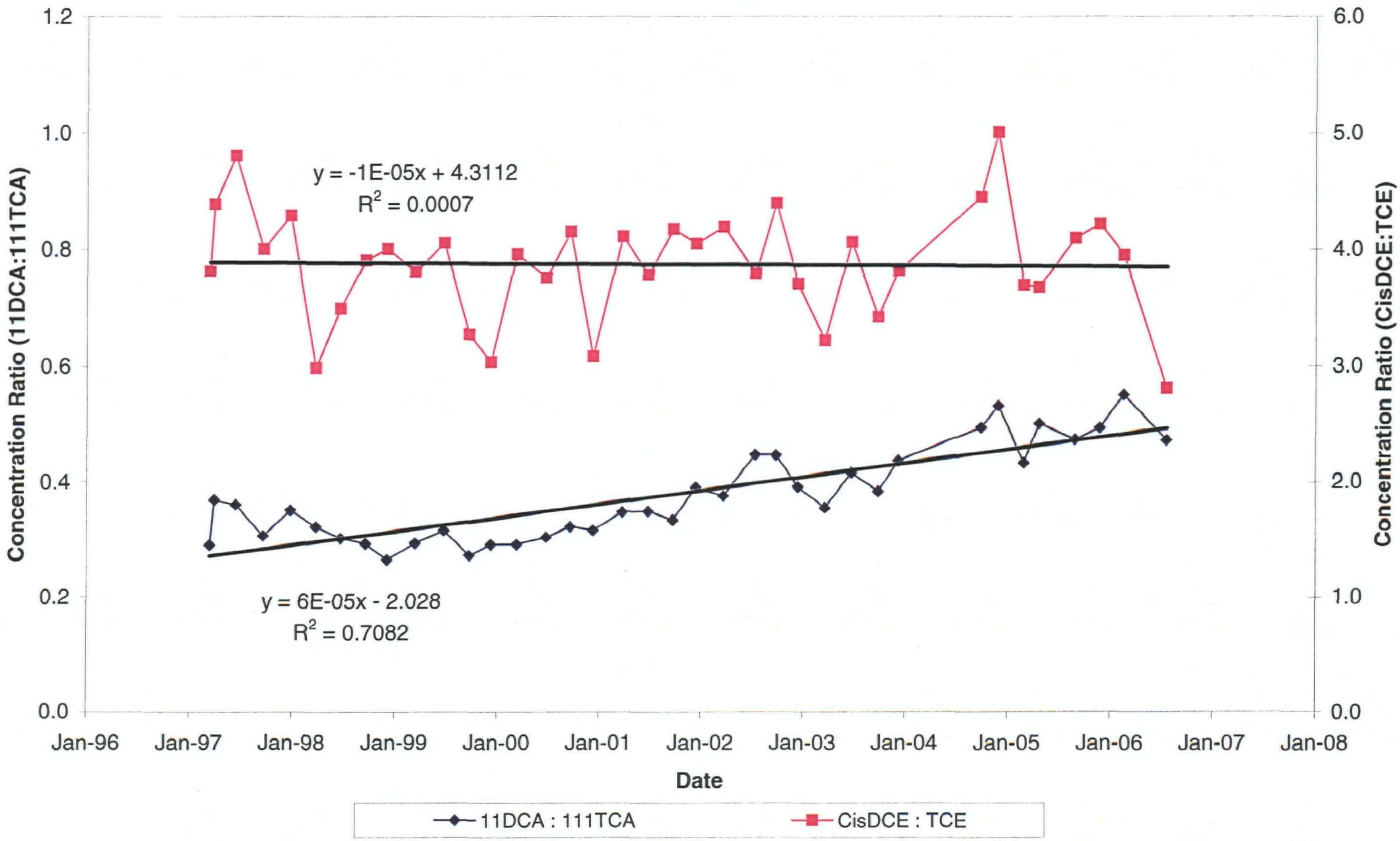


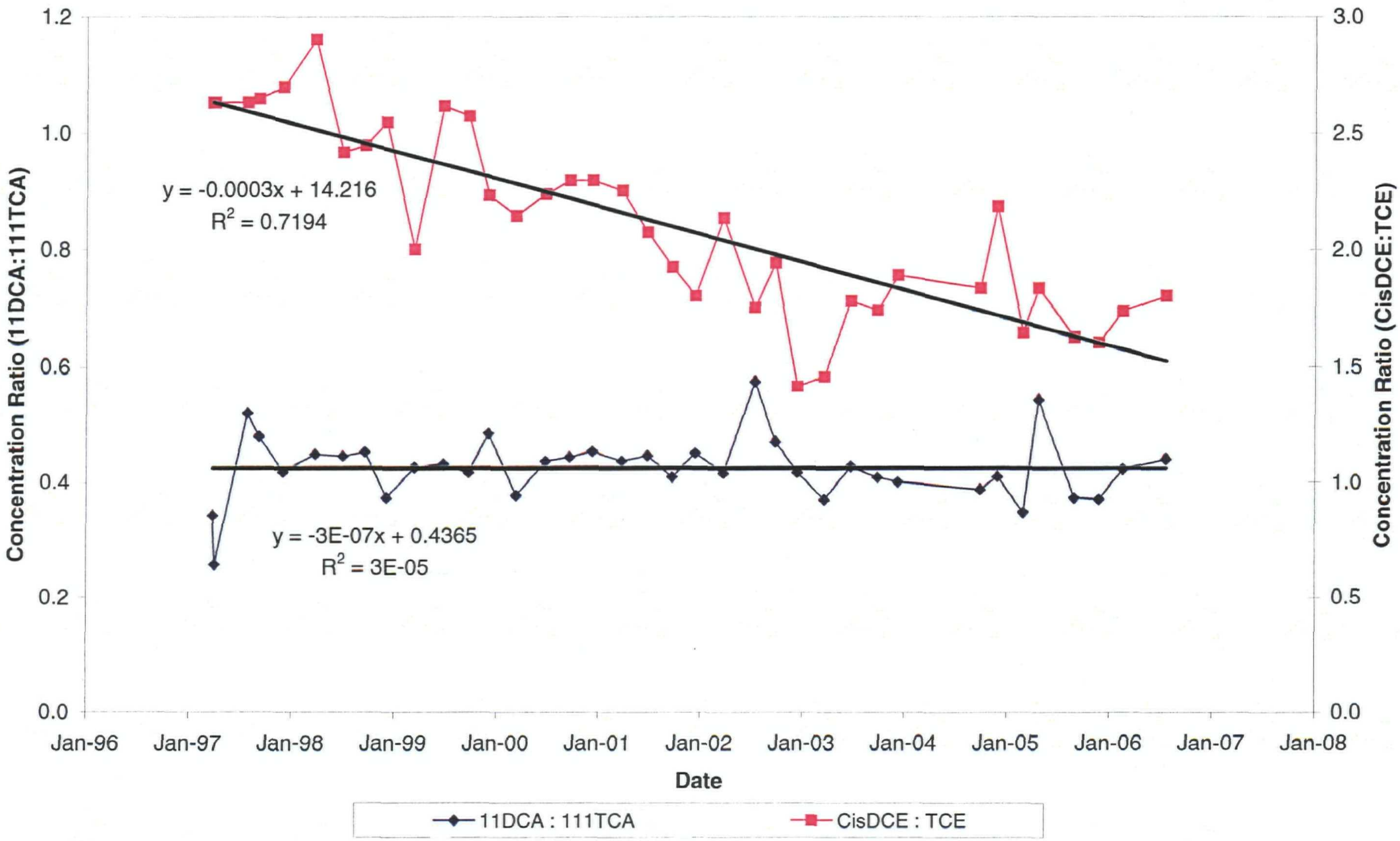
I:\WPMSN\PJT\00-03458\40\000345840-002.XLS 4/17/2009

EW-01D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



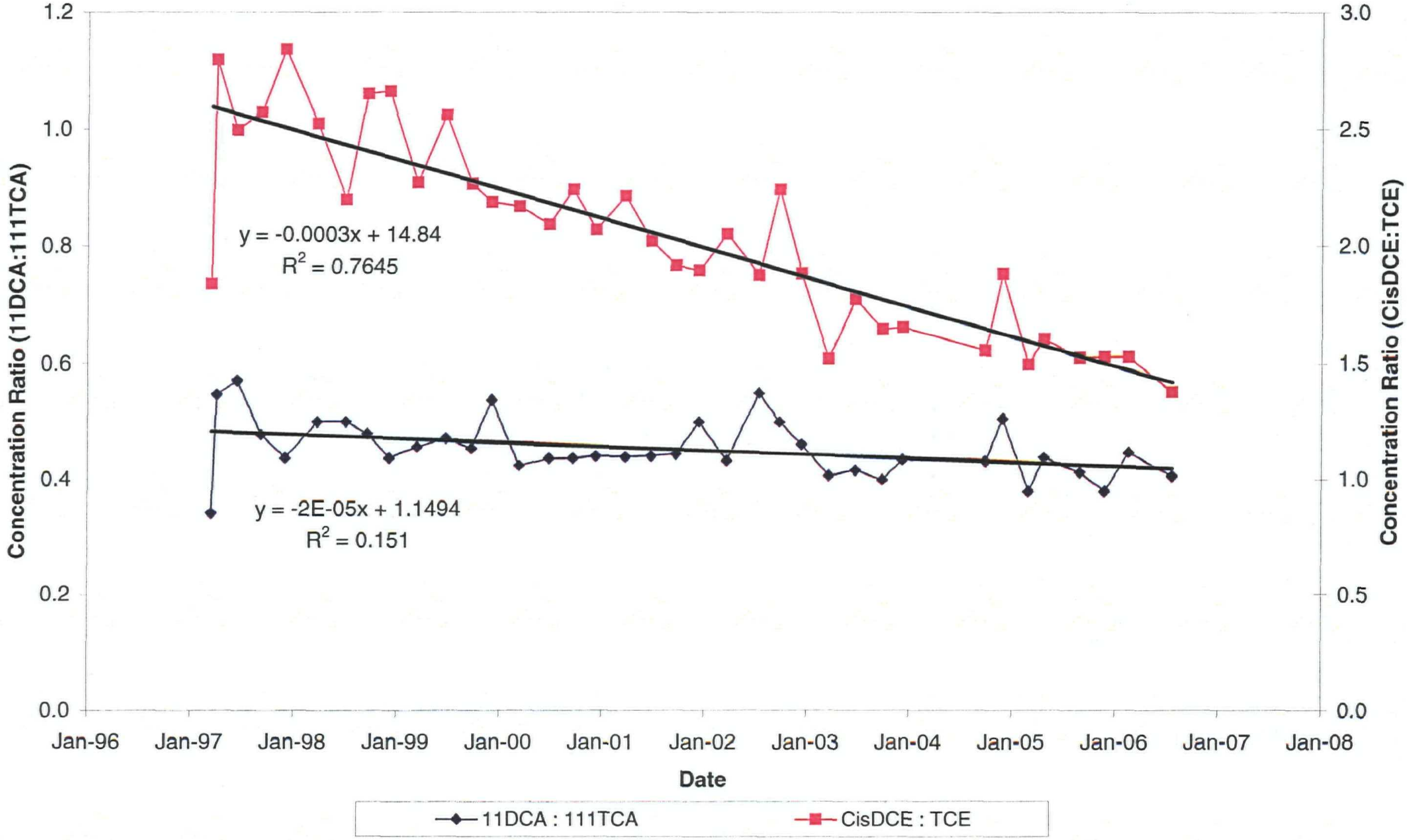
I:\WPMSN\PJT\00-03458\40\000345840-002.XLS 4/17/2009

EW-03D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



I:\WPMSN\PJT\00-03458\40\000345840-002.XLS 4/17/2009

EW-04D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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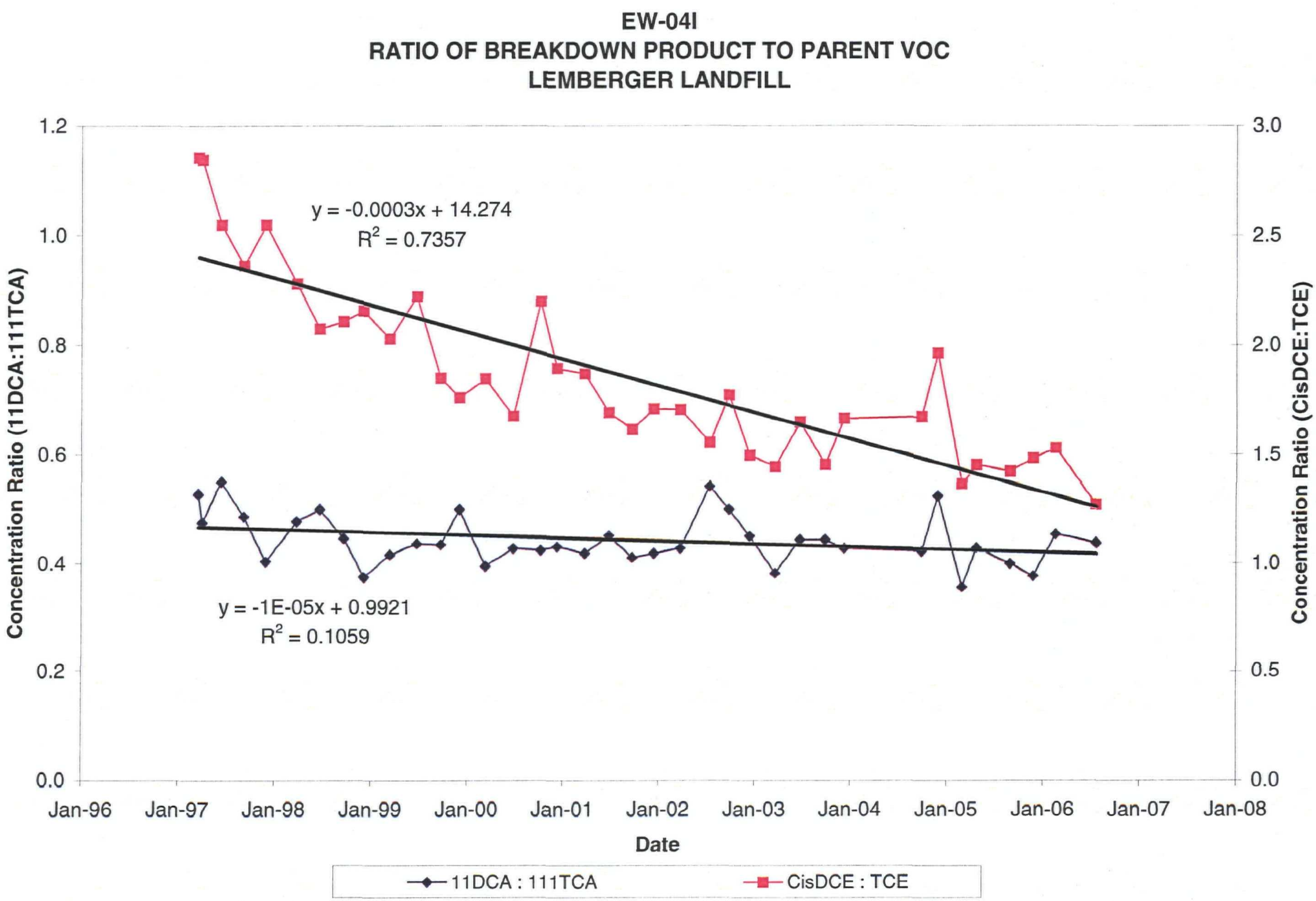

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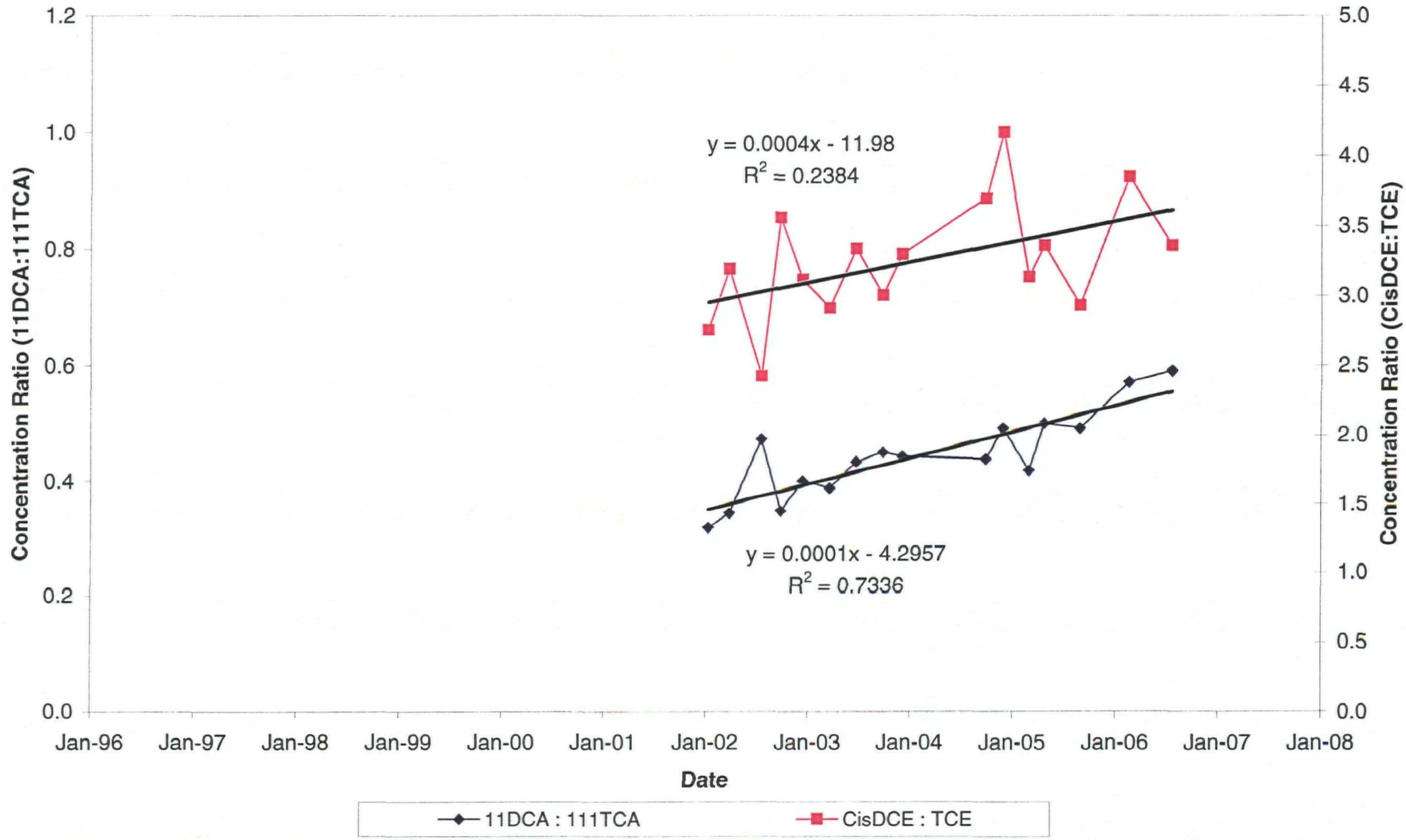
EW-06D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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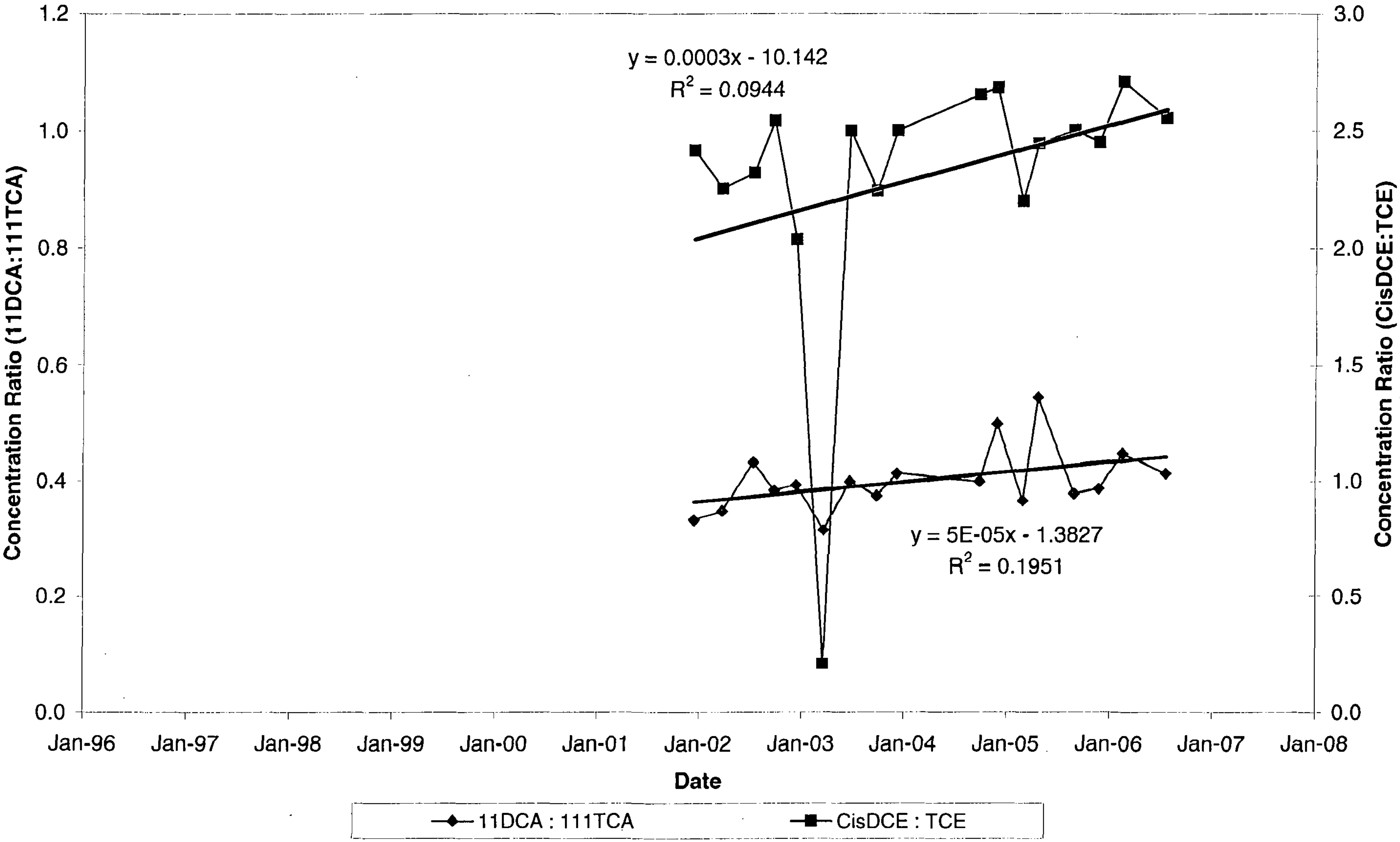
EW-07D
RATIO OF BREAKDOWN PRODUCT TO PARENT VOC
LEMBERGER LANDFILL



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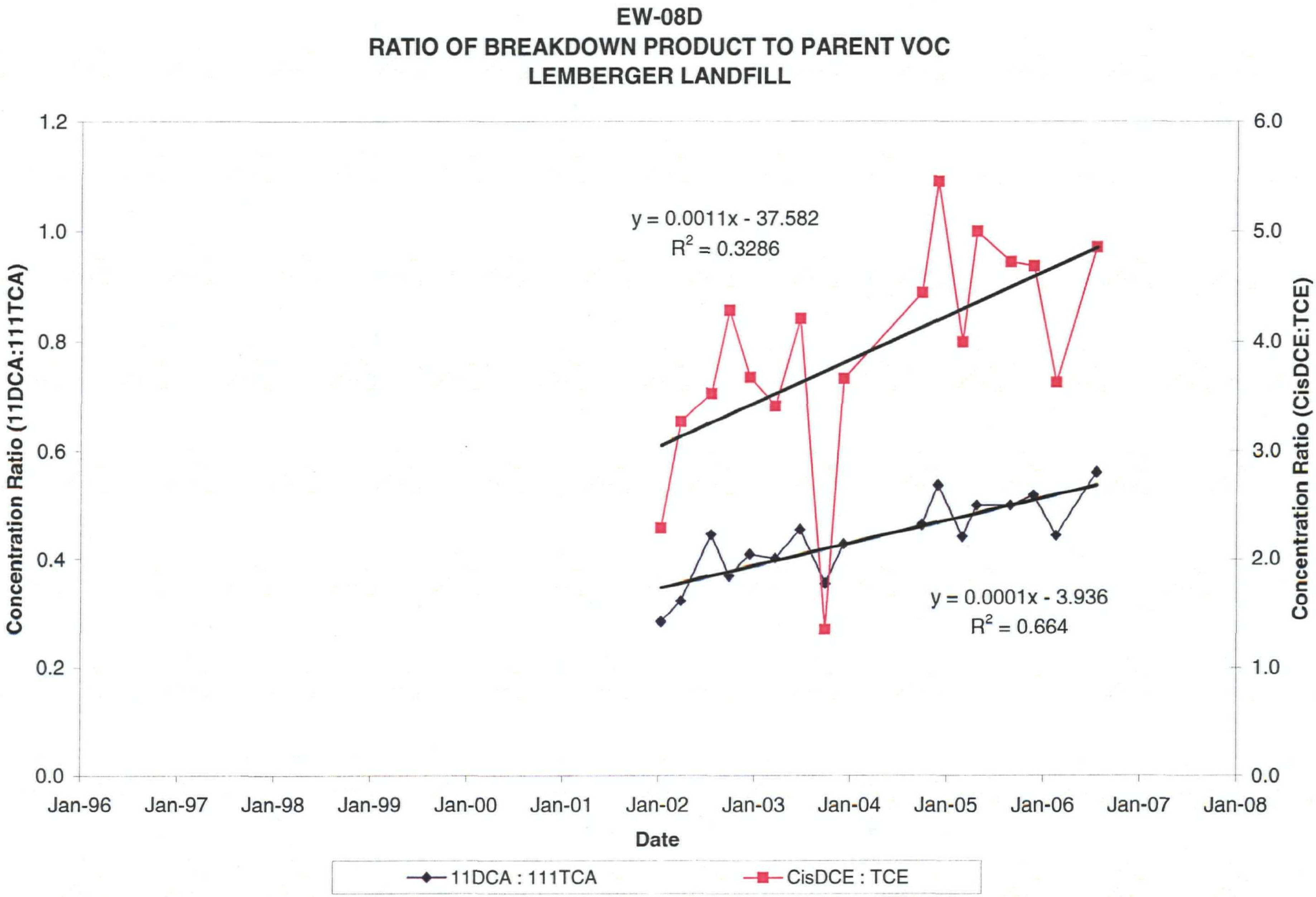

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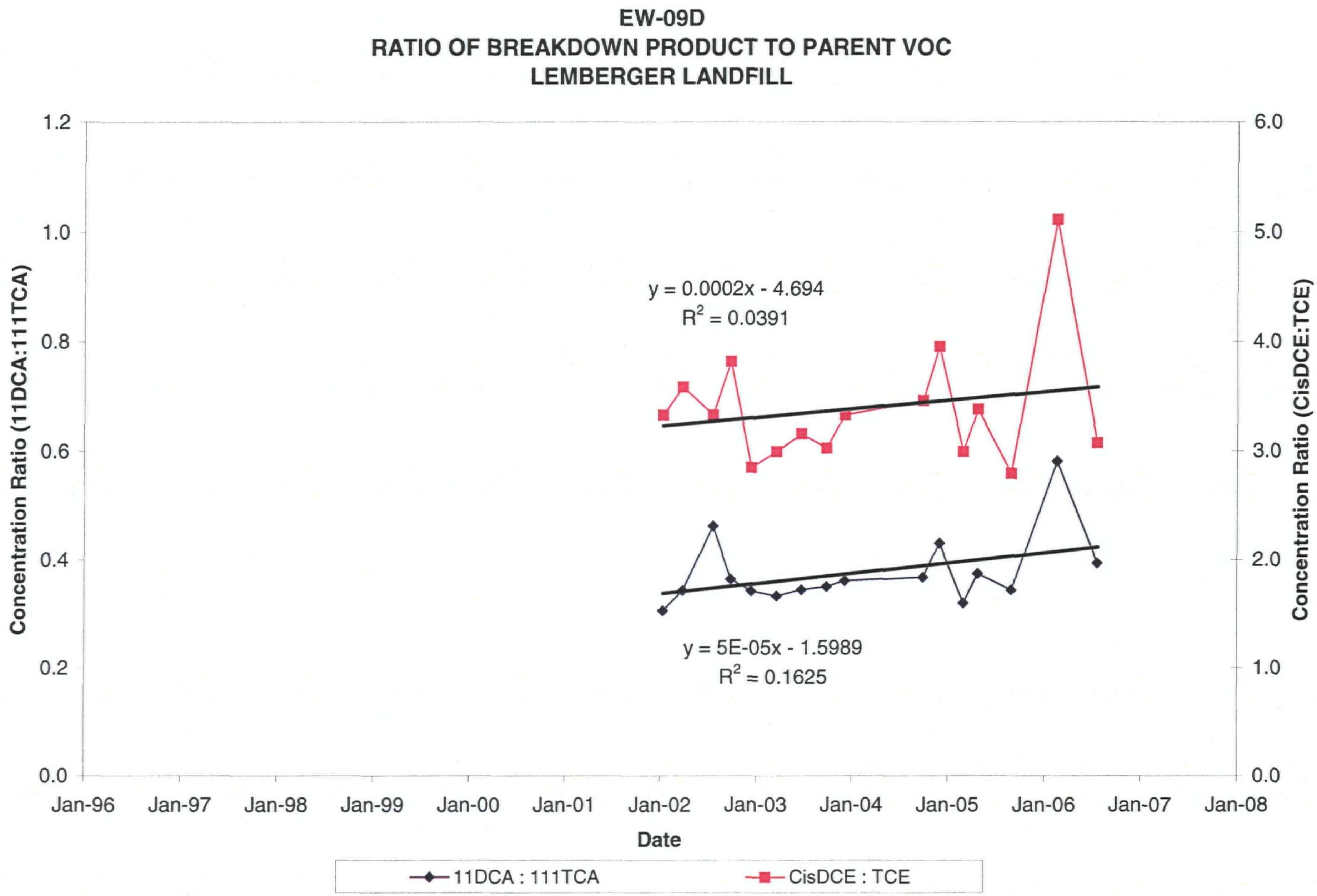

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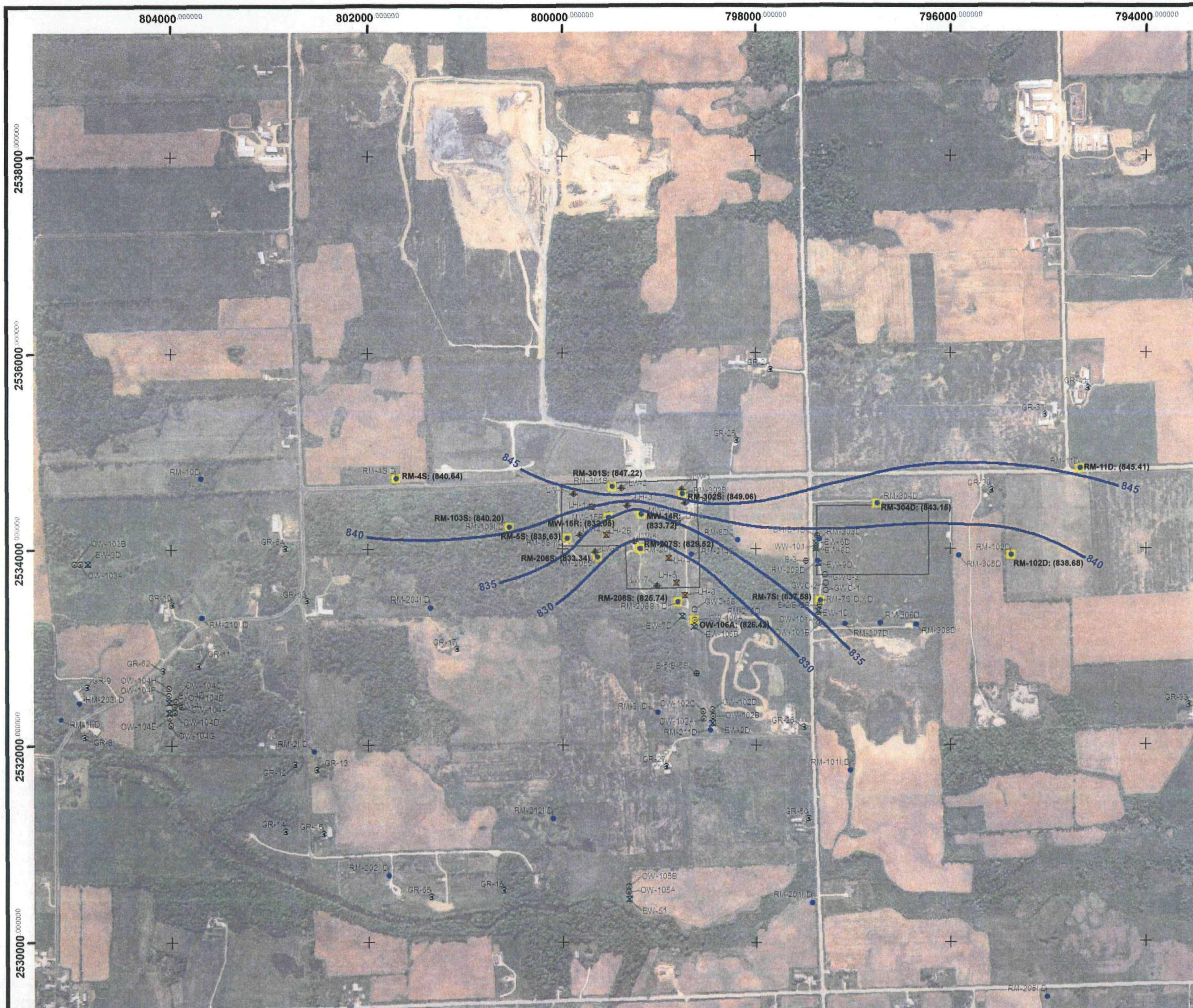
Attachment 4
Groundwater Contour Maps



LEGEND

- ELEVATION CONTOUR FT MSL, 2 FT CONTOUR INTERVAL (DASHED WHERE INFERRED)
- BEDROCK BORING
- GW COLLECTION SUMP
- GW EXTRACTION WELL
- GW OBSERVATION WELL
- LEACHATE HEAD WELL
- LEACHATE WITHDRAWL WELL
- MONITORING WELL
- RESIDENTIAL WELL
- PERCHED WATER TABLE WELL LOCATION AND WATER TABLE ELEVATIONS (FT MSL)
- LANDFILL AREA

NOTES

1. AERIAL IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 2005.
2. MAP COORDINATES ARE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FEET.
3. WATER ELEVATIONS MEASURED SEPTEMBER 8, 2006.

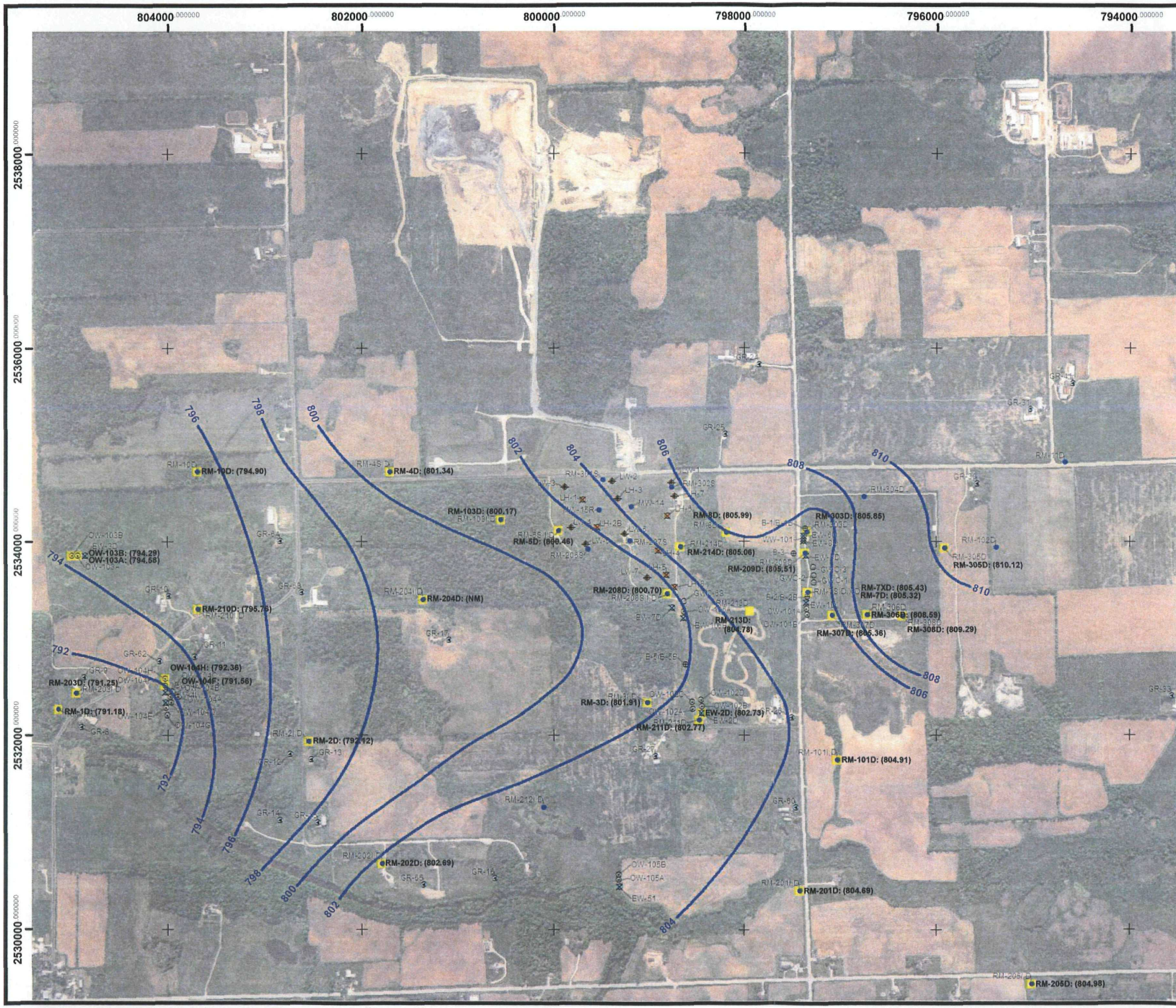
0 1,000 2,000 FEET

1" = 1,000'
1:12,000

PROJECT:	LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN		
SHEET TITLE:	PERCHED WATER TABLE SEPTEMBER 2006		
DRAWN BY: HANKLEY C	SCALE:	PROJ. NO.	00-03456.40
CHECKED BY: CLAUSEN T	AS NOTED	FILE NO.	34544703.mxd
APPROVED BY: WEDEKIND J	DATE PRINTED:	FIGURE 2	
DATE: JULY 2007	7/23/2007		

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

D:\03454\47\GIS\34544703.mxd 7/23/2007 09:40:35



D:\03454\47\GIS\34544704.mxd 7/23/2007 09:45:33

LEGEND

- POTENTIOMETRIC SURFACE ELEVATION CONTOUR FT. MSL, 2-FT CONTOUR INTERVAL (DASHED WHERE INFERRED)
- MONITORING WELL LOCATION ADN WATER ELEVATION (FT MSL)
- ⊕ BEDROCK BORING
- ○ GW COLLECTION SUMP
- GW EXTRACTION WELL
- ⊙ GW OBSERVATION WELL
- LEACHATE HEAD WELL
- LEACHATE WITHDRAWL WELL
- ● MONITORING WELL
- RESIDENTIAL WELL

NOTES

1. AERIAL IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 2005.
2. MAP COORDINATES ARE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FEET.
3. WATER ELEVATIONS MEASURED ON SEPTEMBER 8, 2006.
4. THE MAPPED POTENTIOMETRIC SURFACE INCLUDES BEDROCK WATER TABLE OBSERVATIONS WELLS (SOUTH AND EAST) AND BEDROCK PIEZOMETERS (NORTH AND WEST).

0 1,000 2,000 FEET

1" = 1,000'
1:12,000

MAP LOCATION

PROJECT: LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN			
SHEET TITLE: POTENTIOMETRIC SURFACE ELEVATION BEDROCK UNIT SEPTEMBER 2006			
DRAWN BY: HANKLEY C	SCALE:	PROJ. NO.	00-003456.40
CHECKED BY: CLAUSEN T	AS NOTED	FILE NO.	34544704.mxd
APPROVED BY: WEDEKIND J	DATE PRINTED: 7/23/2007	FIGURE 3	
DATE: JULY 2007			

RMT

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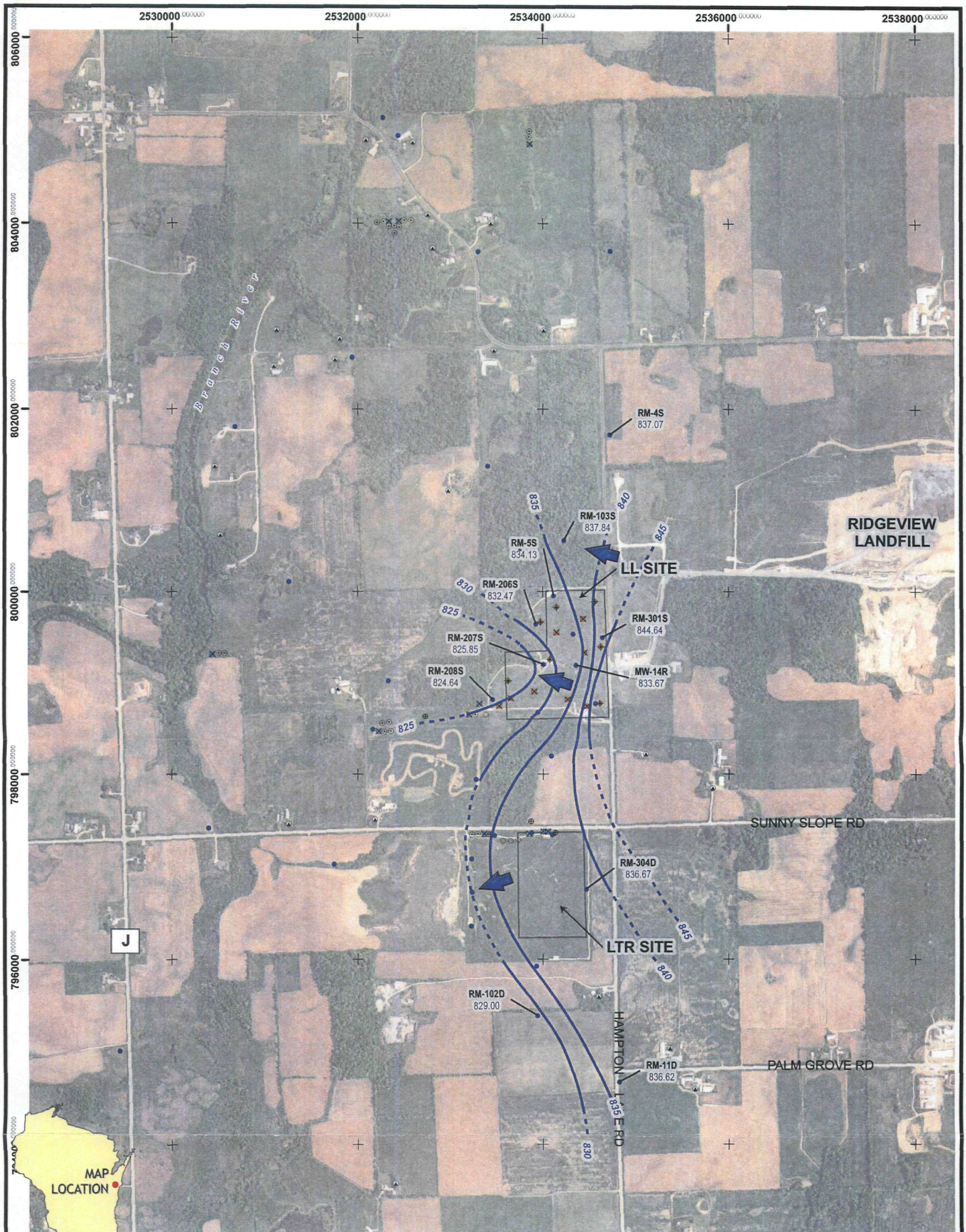
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334



LEGEND

SAMPLE AND MONITORING LOCATIONS

- ⊕ BEDROCK BORING
- ○ GW COLLECTION SUMP (GWC)
- ✖ GW EXTRACTION WELL (EW)
- ⊙ GW OBSERVATION WELL (OW)
- ✖ LEACHATE HEAD WELL (LH)
- ✦ LEACHATE WITHDRAWL WELL (LW)
- ● MONITORING WELL (RM)
- ◉ RESIDENTIAL WELL (GW)
- ▭ LANDFILL AREA

INFERRED GROUNDWATER FLOW DIRECTION

PERCHED WATER TABLE WELL LOCATION AND WATER TABLE ELEVATIONS (FT MSL)

RM-11D
(842.33)

Elevation Contour FT MSL.
2 FT Contour Interval
(Dashed Where Inferred)

801

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES ARE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. WATER ELEVATIONS MEASURED DECEMBER 18, 2007.

0 1,000 FEET
1" = 1,000'
1:12,000

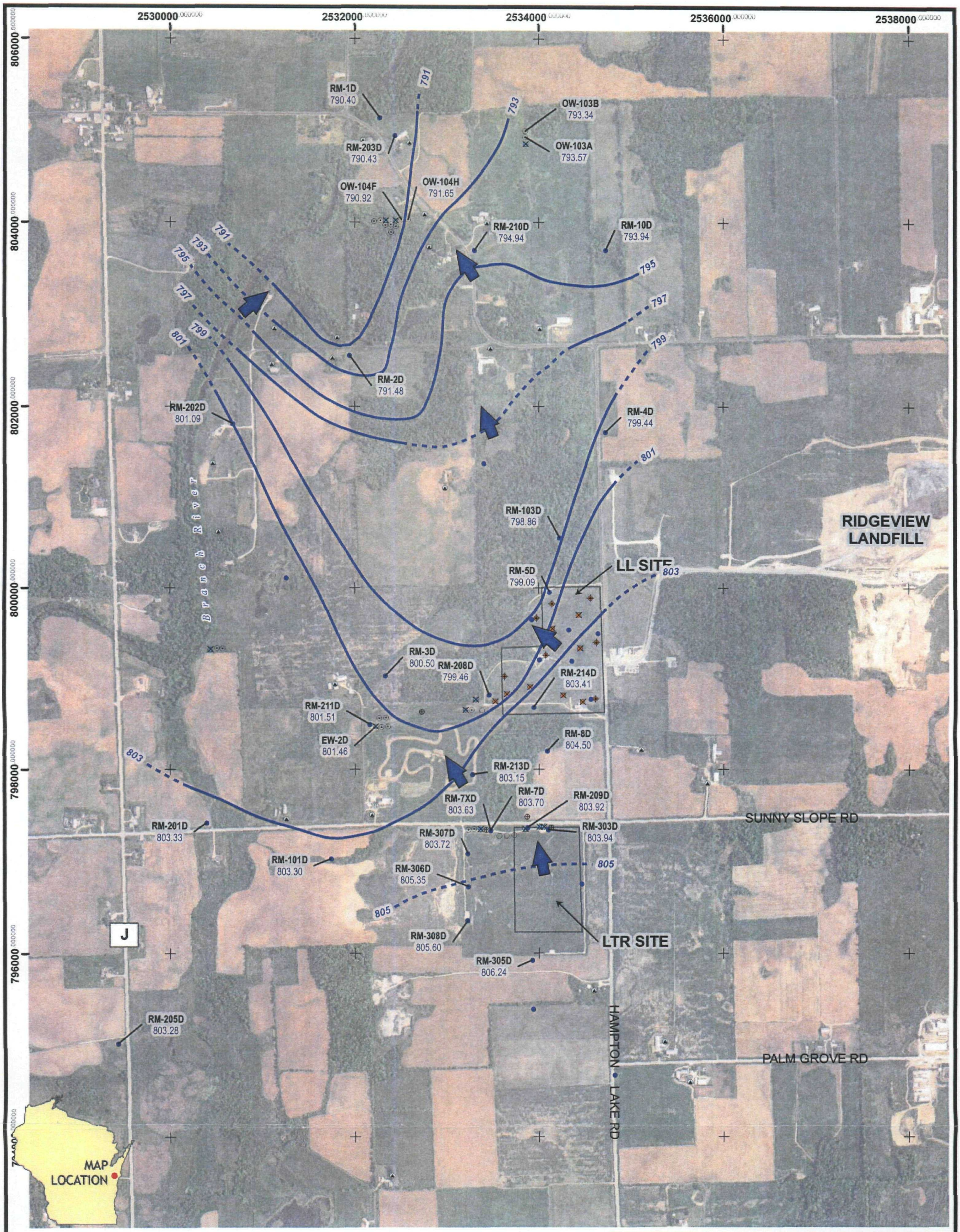
N

PROJECT:	LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN				
SHEET TITLE:	PERCHED WATER TABLE DECEMBER 2007				
DRAWN BY:	BENTON K	SCALE:		PROJ. NO.	00-03457.44
CHECKED BY:	CLAUSEN T	AS NOTED		FILE NO.	34574402.mxd
APPROVED BY:	WEDEKIND J	DATE PRINTED:		FIGURE 2	
DATE:	AUGUST 2008	8/11/2008			

RMT

744 Heartland Trail
Madison, WI 53717-1934

P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334



LEGEND

SAMPLE AND MONITORING LOCATIONS

- BEDROCK BORING
- GW COLLECTION SUMP (GWC)
- GW EXTRACTION WELL (EW)
- GW OBSERVATION WELL (OW)
- LEACHATE HEAD WELL (LH)
- LEACHATE WITHDRAWL WELL (LW)
- MONITORING WELL (RM)
- RESIDENTIAL WELL (GW)
- LANDFILL AREA

INFERRED GROUNDWATER FLOW DIRECTION

BEDROCK LOCATION AND GROUNDWATER ELEVATIONS (FT MSL)

RM-205D
(804.83)

Elevation Contour FT MSL.
2 FT Contour Interval
(Dashed Where Inferred)

801

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES ARE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. WATER ELEVATIONS MEASURED DECEMBER 18, 2007.
4. THE MAPPED POTENTIOMETRIC SURFACE INCLUDES BEDROCK WATER TABLE OBSERVATION WELLS (SOUTH AND EAST) AND BEDROCK PIEZOMETERS (NORTH AND WEST).

N

0 1,000 FEET 1:12,000
1 " = 1,000 '

PROJECT:	LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN
SHEET TITLE:	POTENTIOMETRIC SURFACE ELEVATION BEDROCK UNIT DECEMBER 2007

DRAWN BY:	BENTON K	SCALE:		PROJ. NO.	00-03457.44
CHECKED BY:	CLAUSEN T		AS NOTED	FILE NO.	34574404.mxd
APPROVED BY:	WEDEKIND J	DATE PRINTED:		FIGURE 3	
DATE:	AUGUST 2008		8/11/2008		

RMT

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

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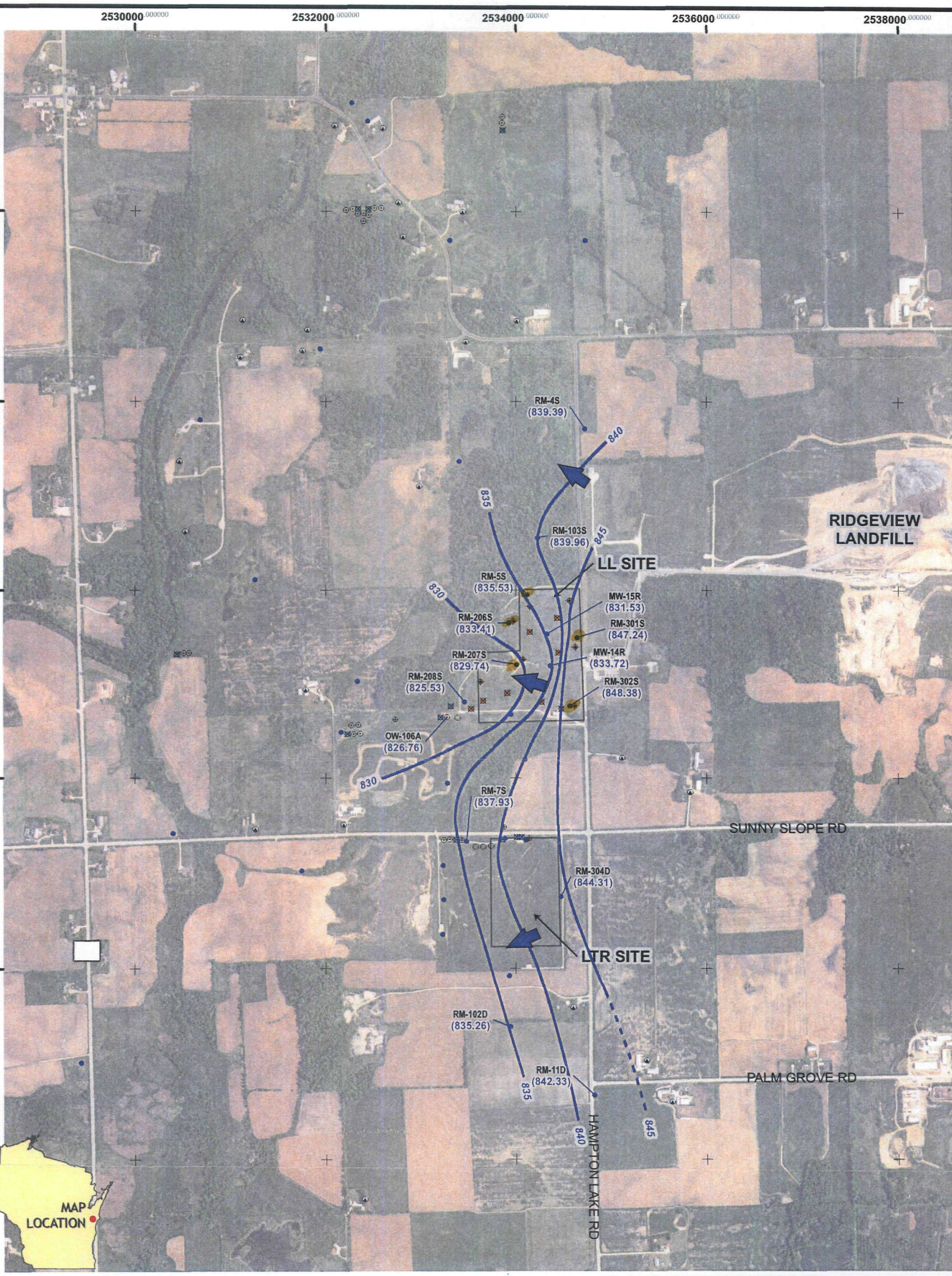

LEGEND

SAMPLE AND MONITORING LOCATIONS

- ⊕ BEDROCK BORING
- ○ GW COLLECTION SUMP (GWC)
- GW EXTRACTION WELL (EW)
- ⊙ GW OBSERVATION WELL (OW)
- LEACHATE HEAD WELL (LH)
- LEACHATE WITHDRAWL WELL (LW)
- ● MONITORING WELL (RM)
- RESIDENTIAL WELL (GW)
- LANDFILL AREA

-20— ELEVATION CONTOUR FT MSL, 2 FT CONTOUR INTERVAL *(DASHED WHERE INFERRED)*

PERCHED WATER TABLE WELL LOCATION AND WATER TABLE ELEVATIONS (FT MSL)

RM-11D
(842.33)

INFERRED GROUNDWATER FLOW DIRECTION

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES ARE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. WATER ELEVATIONS MEASURED JULY 18, 2007.

N

0 1,000 FEET
1 " EQUALS 1,000 '
1:12,000

PROJECT:	**LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN**		
SHEET TITLE:	**PERCHED WATER TABLE JULY 2007**		
DRAWN BY: HANKLEY C	SCALE:	PROJ. NO.	00-03456.43
CHECKED BY: CLAUSEN T	AS NOTED	FILE NO.	34564303.mxd
APPROVED BY: WEDEKIND J	DATE PRINTED:	**FIGURE 2**	
DATE: JANUARY 2008	1/23/2008		

RMT

744 Heartland Trail
Madison, WI 53717-1934

P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

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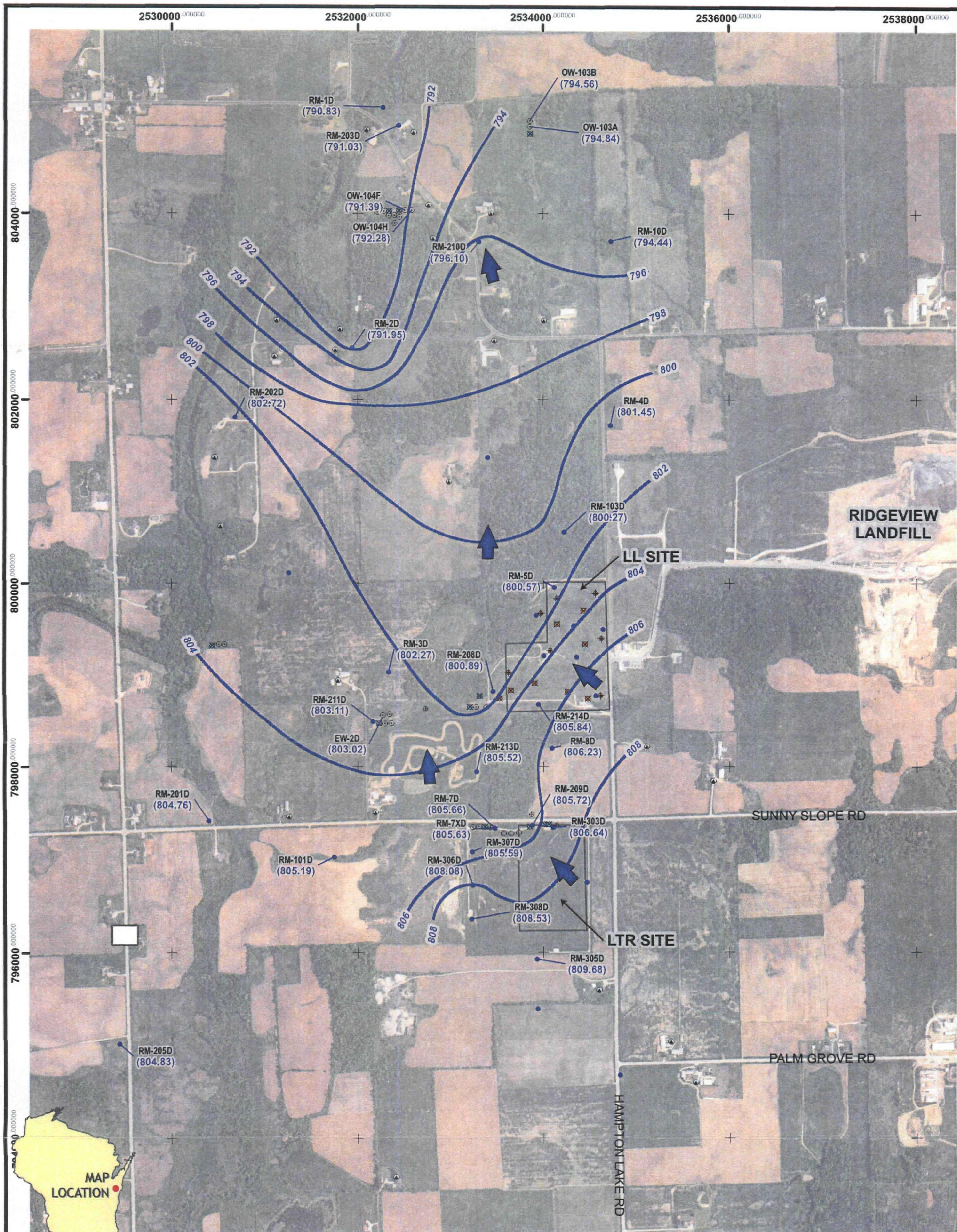
Proposed annual sampling
Section 9.



LEGEND

SAMPLE AND MONITORING LOCATIONS

- BEDROCK BORING
- GW COLLECTION SUMP (GWC)
- GW EXTRACTION WELL (EW)
- GW OBSERVATION WELL (OW)
- LEACHATE HEAD WELL (LH)
- LEACHATE WITHDRAWL WELL (LW)
- MONITORING WELL (RM)
- RESIDENTIAL WELL (GW)
- LANDFILL AREA

–20– POTENTIOMETRIC SURFACE ELEVATION CONTOUR FT MSL, 2 FT CONTOUR INTERVAL *(DASHED WHERE INFERRED)*

BEDROCK LOCATION AND GROUNDWATER ELEVATIONS (FT MSL)

RM-205D
(804.83)

INFERRED GROUNDWATER FLOW DIRECTION

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES ARE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. WATER ELEVATIONS MEASURED JULY 18, 2007.
4. THE MAPPED POTENTIOMETRIC SURFACE INCLUDES BEDROCK WATER TABLE OBSERVATION WELLS (SOUTH AND EAST) AND BEDROCK PIEZOMETERS (NORTH AND WEST).

N

0 — 1,000 FEET

1" EQUALS 1,000'

1:12,000

PROJECT:	LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN		
SHEET TITLE:	POTENTIOMETRIC SURFACE ELEVATION BEDROCK UNIT JULY 2007		
DRAWN BY: HANKLEY C	SCALE:	PROJ. NO.	00-03456.43
CHECKED BY: CLAUSEN T	AS NOTED	FILE NO.	34564304.mxd
APPROVED BY: WEDEKIND J	DATE PRINTED: 1/23/2008	**FIGURE 3**	
DATE: JANUARY 2008			

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Attachment 5
Map of Subsurface Geology

LEGEND

SAMPLE AND MONITORING LOCATIONS

- BEDROCK BORING
- GW COLLECTION SUMP (GWC)
- GW EXTRACTION WELL (EW)
- GW OBSERVATION WELL (OW)
- LEACHATE HEAD WELL (LH)
- LEACHATE WITHDRAWL WELL (LW)
- MONITORING WELL (RM)
- RESIDENTIAL WELL (GW)

LANDFILL AREA

SUBSURFACE UNIT CONTACT LINE (DASHED WHERE INFERRED)

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2008.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.

0 1,000 FEET

1" = 1,000'

1:12,000

N

PROJECT:	LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN		
SHEET TITLE:	SITE PLAN SHOWING ALL MONITORING POINTS SUBSURFACE CONDITIONS		
DRAWN BY: PAPEZ J	SCALE:	PROJ. NO. 00-03458.40	
CHECKED BY: JW	AS NOTED	FILE NO. 34584002.mxd	
APPROVED BY: KDK	DATE PRINTED: 4/9/2009	FIGURE 1	
DATE: APRIL 2009			

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Attachment 6
Statistical Analysis Summary

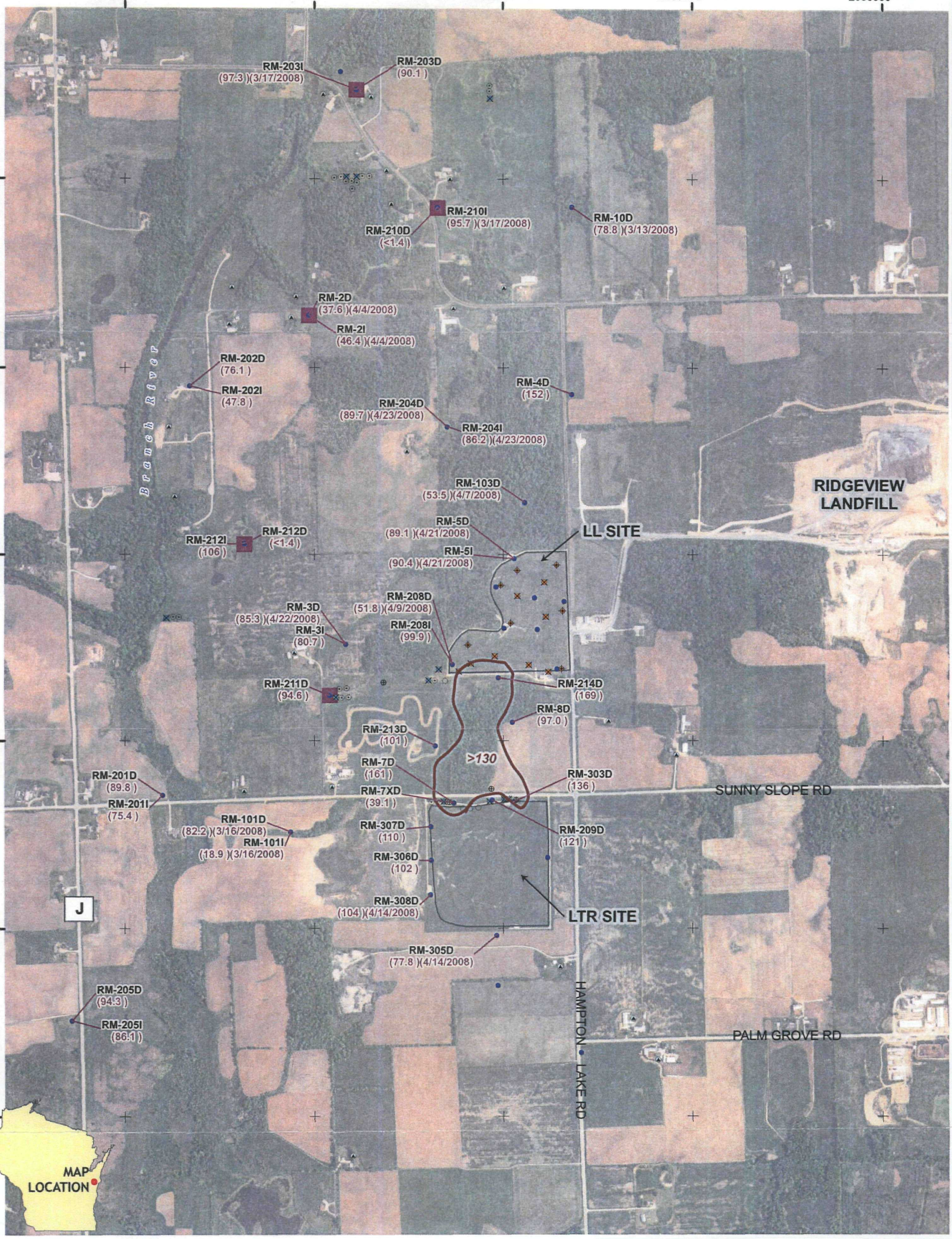
Table
Summary of Sen's Slope Statistical Analyses
Lemberger Landfill and Lemberger Transport and Recycling Sites

WELL	ALL HISTORICAL DATA				DATA SINCE MNA START-UP			
	1,1,1-TCA	1,1-DCA	TOTAL-1,2-DCE(1)	TCE	1,1,1-TCA	1,1-DCA	CIS-1,2-DCE	TCE
RM-002D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No detections	No trend	No detections	No trend
RM-002I	Decreasing trend	Decreasing trend	No trend	Decreasing trend	No trend	No trend	No trend	No detections
RM-003D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-003I	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend	No detections	No detections
RM-004D	**Increasing trend**	**Increasing trend**	No detections	No detections	No detections	No detections	No detections	No detections
RM-005D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-005I	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-007D	No trend	**Increasing trend**	**Increasing trend**	No trend	No trend	No trend	No trend	No trend
RM-007XD	**Increasing trend**	**Increasing trend**	**Increasing trend**	**Increasing trend**	No trend	No trend	No trend	No trend
RM-008D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-010D	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend	No trend	No trend
RM-101D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No detections	No trend
RM-103D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-203D	No trend	Decreasing trend	No trend	No trend	No trend	No trend	No trend	No trend
RM-203I	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend	No detections	No detections
RM-204D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	Decreasing trend
RM-204I	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-208D	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend
RM-208I	Decreasing trend	Decreasing trend	No trend	Decreasing trend	No trend	No trend	No detections	No detections
RM-209D	Decreasing trend	**Increasing trend**	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-210D	Decreasing trend	No trend	Decreasing trend	No trend	No trend	No trend	No trend	Decreasing trend
RM-210I	Decreasing trend	Decreasing trend	Decreasing trend	Decreasing trend	No trend	No trend	No trend	No trend
RM-211D	No trend	No trend	No detections	No trend	No trend	No trend	No detections	No trend
RM-213D	No trend	No trend	No data	No trend	No trend	No trend	No trend	No trend
RM-214D	No trend	No trend	No data	No trend	No trend	No trend	No trend	No trend
RM-303D	Decreasing trend	No trend	No trend	No trend	No trend	No trend	No trend	No trend
RM-304D	Decreasing trend	No trend	No detections	Decreasing trend	Decreasing trend	No detections	No detections	No detections
RM-305D	Decreasing trend	No detections	No detections	Decreasing trend	No trend	No detections	No detections	No trend
RM-306D	Decreasing trend	**Increasing trend**	Decreasing trend	No trend	No trend	No trend	No trend	No trend
RM-307D	Decreasing trend	**Increasing trend**	**Increasing trend**	Decreasing trend	No trend	No trend	No trend	No trend
RM-308D	No trend	No detections	No detections	No detections	No trend	No detections	No detections	No detections

Notes:

(1) Prior to the MNA demonstration, only total-1,2-dichloroethene was reported; reporting of the cis- and trans- isomers began with the "baseline analysis" in July 2006, prior to the MNA demonstration period.

Attachment 7
Revised MNA Summary Maps



LEGEND

- MONITORING WELL (RM)
- SENTINEL WELLS
- >130 TIC ISO-CONCENTRATION

TIC SAMPLES USED FOR ISO-LINES
LABELS SHOW CONCENTRATION (MG/L) AND SAMPLE DATE IF SAMPLE WAS TAKEN EARLIER THAN JULY 2008

RM-3D
(85.3)(4/22/2008)

- LANDFILL AREA

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. J OR Q = RESULT IS BETWEEN THE LOD AND LOQ.
4. RM-7XD WAS NOT USED FOR CONTOURING.

N

0 1,000 FEET
1" = 1,000'
1:12,000

PROJECT: **LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN**

SHEET TITLE: **TOTAL INORGANIC CARBON CONCENTRATIONS LGU AND BEDROCK UNIT-JULY 2008**

DRAWN BY: MCKEEFRY J	SCALE:	PROJ. NO.	00-03457.46
CHECKED BY: THC	AS NOTED	FILE NO.	34574612.mxd
APPROVED BY: JDW	DATE PRINTED: 12/22/2008	**FIGURE 12**	
DATE: DECEMBER 2008			

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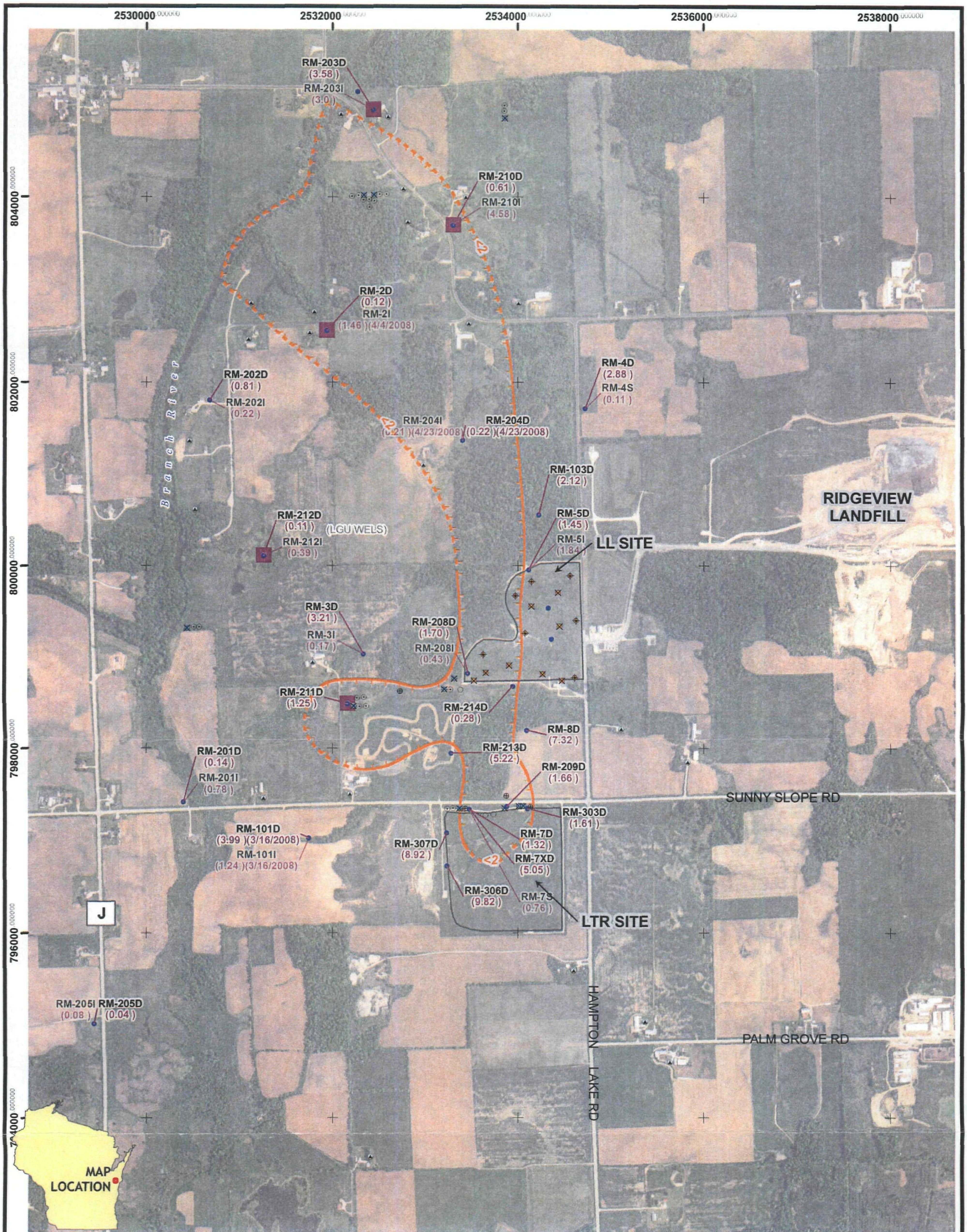

LEGEND

- MONITORING WELL (RM)
- SENTINEL WELLS
- LANDFILL AREA

DO ISO-CONCENTRATION (MG/L)

<2

DO SAMPLES USED FOR ISO-LINES

LABELS SHOW CONCENTRATION (MG/L) AND SAMPLE DATE IF SAMPLE WAS TAKEN EARLIER THAN JULY 2008. HIGHLIGHTED LABELS REPRESENT SAMPLES FROM WELLS SCREENED IN BEDROCK.

RM-208
(825.53)

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. WELLS/RESULTS SHOWN IN BOLD FONT WERE USED FOR CONTOURING.
4. BEDROCK WELLS RM-205D, RM-201D AND RM-202D WERE NOT USED FOR CONTOURING BECAUSE LOWER CONCENTRATIONS OF DO AT THESE WELLS ARE NATURALLY OCCURRING.

N

0 1,000 FEET
1" = 1,000'
1:12,000

PROJECT:	LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN		
SHEET TITLE:	DISSOLVED OXYGEN CONCENTRATIONS LGU AND BEDROCK UNIT-JULY 2008 (ISO-CONCENTRATIONS FOR BEDROCK WELLS ONLY)		
DRAWN BY: PAPEZ J	SCALE:	PROJ. NO.	00-0345840
CHECKED BY: THC	AS NOTED	FILE NO.	34584004.mxd
APPROVED BY: JDW	DATE PRINTED: 4/6/2009	FIGURE 14	
DATE: APRIL 2009			

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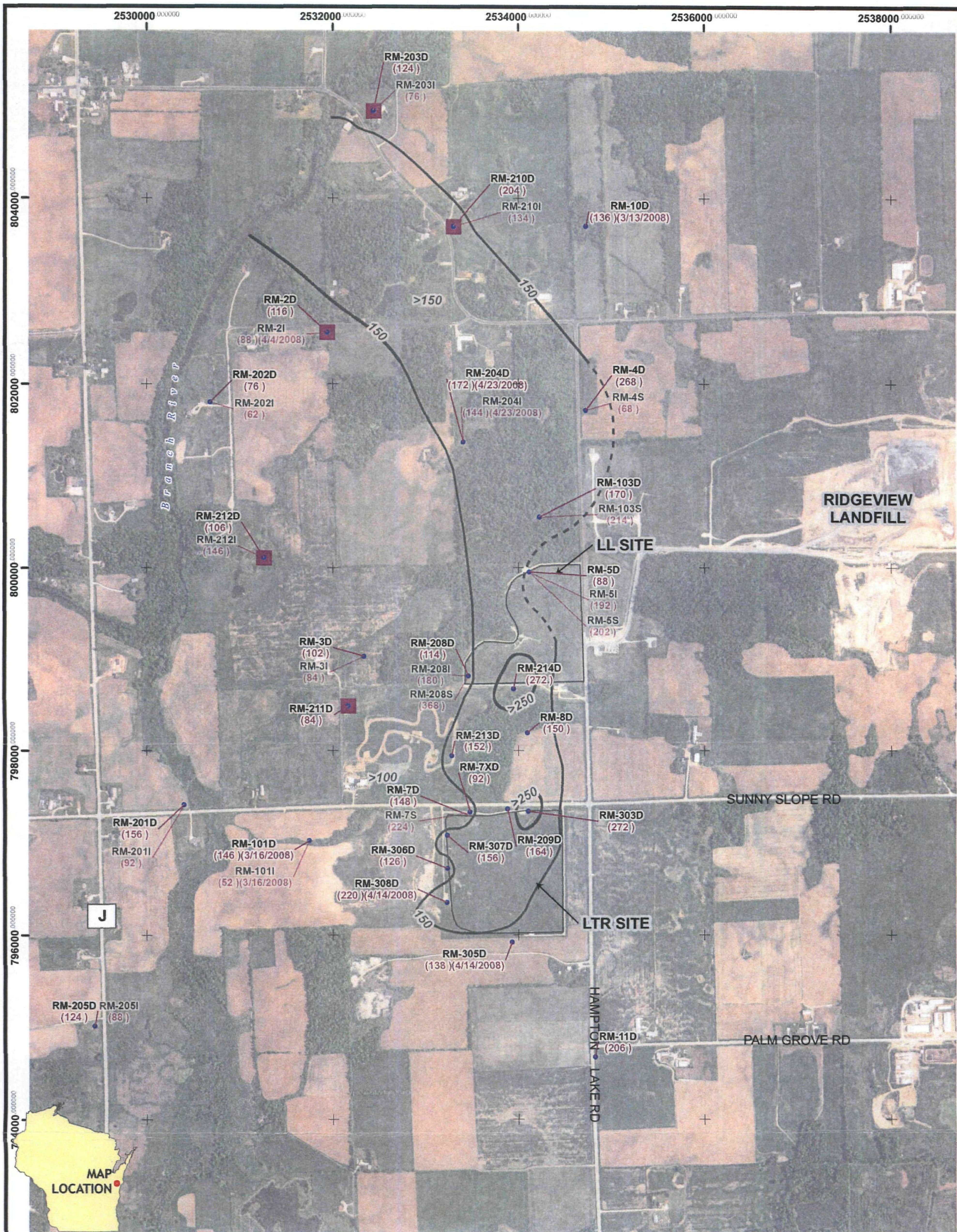

LEGEND

- MONITORING WELL (RM)
- SENTINEL WELLS
- LANDFILL AREA
- 20 — CO_2 ISO-CONCENTRATION **FOR BEDROCK ONLY** *(DASHED WHERE INFERRED)*

CO_2 SAMPLES USED FOR ISO-LINES
LABELS SHOW CONCENTRATION (MG/L) AND SAMPLE DATE IF SAMPLE WAS TAKEN EARLIER THAN JULY 2008

RM-208
(825.53)

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. WELLS/RESULTS SHOWN IN BOLD FONT WERE USED FOR CONTOURING.
4. BEDROCK WELLS RM-205D, RM-201D AND RM-202D WERE NOT USED FOR CONTOURING.

N

0 — 1,000 FEET
1 " = 1,000 '
1:12,000

PROJECT:	**LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN**
SHEET TITLE:	**CARBON DIOXIDE CONCENTRATIONS LGU AND BEDROCK UNIT-JULY 2008 (ISO-CONCENTRATIONS FOR BEDROCK WELLS ONLY)**

DRAWN BY:	MCKEEFRY J	SCALE:		PROJ. NO.	00-03457.46
CHECKED BY:	THC	AS NOTED		FILE NO.	34584003.mxd
APPROVED BY:	JDW	DATE PRINTED:		**FIGURE 13**	
DATE:	APRIL 2009	4/6/2009			

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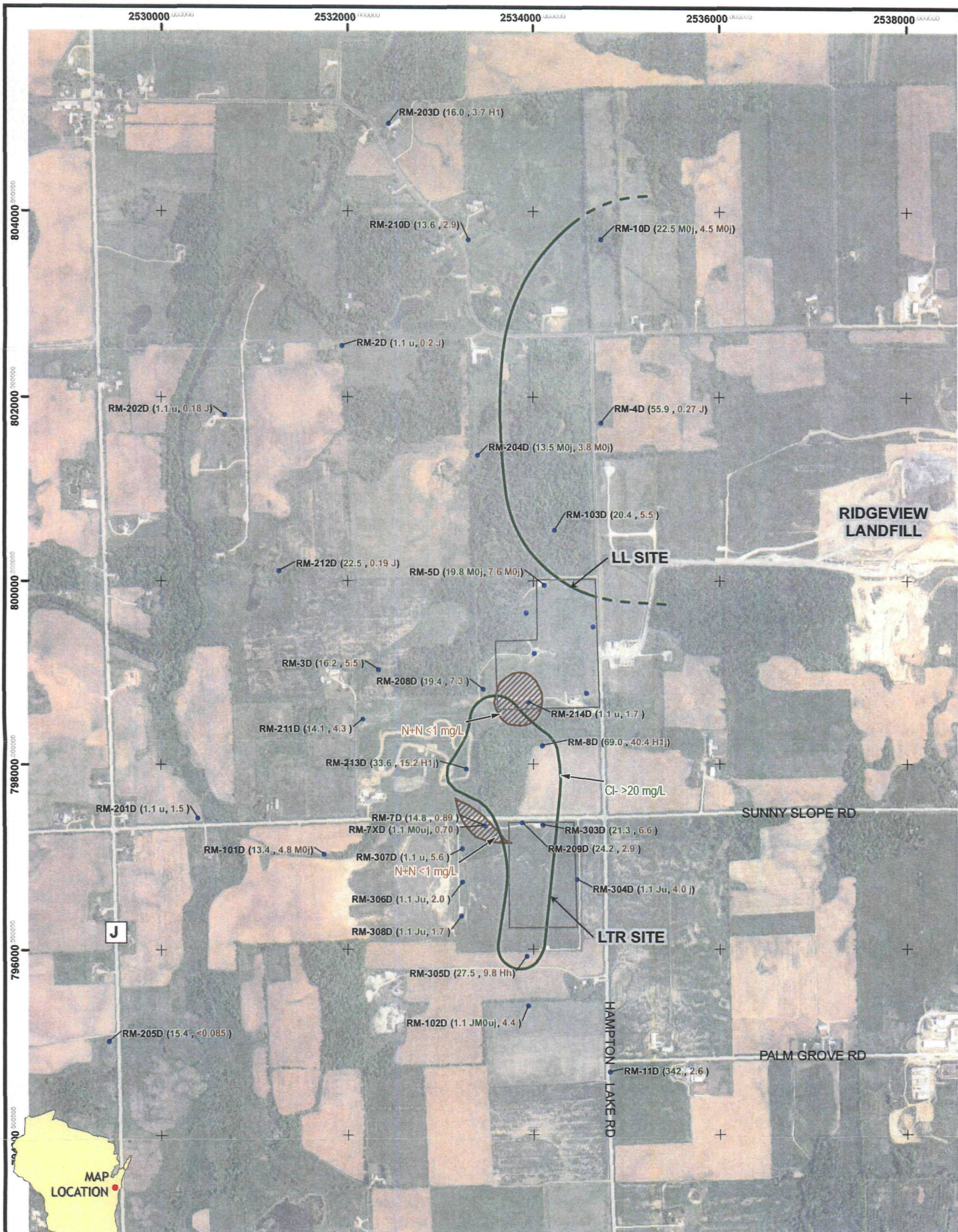

LEGEND

SAMPLE AND MONITORING LOCATIONS

- ⊕ BEDROCK BORING
- ○ GW COLLECTION SUMP (GWC)
- GW EXTRACTION WELL (EW)
- ⊙ GW OBSERVATION WELL (OW)
- LEACHATE HEAD WELL (LH)
- LEACHATE WITHDRAWL WELL (LW)
- ● MONITORING WELL (RM)
- RESIDENTIAL WELL (GW)

SAMPLE ID (Cl- [mg/L], N+N [mg/L])

- LANDFILL AREA
- Cl- >20 mg/L
- N+N <1 mg/L

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. CONCENTRATIONS OUTSIDE THE KNOWN PLUME AREA ARE NOT CONTOURED.

N

0 1,000 FEET

1" = 1,000'

1:12,000

PROJECT: LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN			
SHEET TITLE: DISTRIBUTION OF NITRATE + NITRITE AND CHLORIDE - "D" WELLS JULY 2008			
DRAWN BY: PAPEZ J	SCALE:	PROJ. NO.	00-03458.40
CHECKED BY: JW	AS NOTED	FILE NO.	34584006.mxd
APPROVED BY: KDK	DATE PRINTED:		
DATE: APRIL 2009	4/17/2009		

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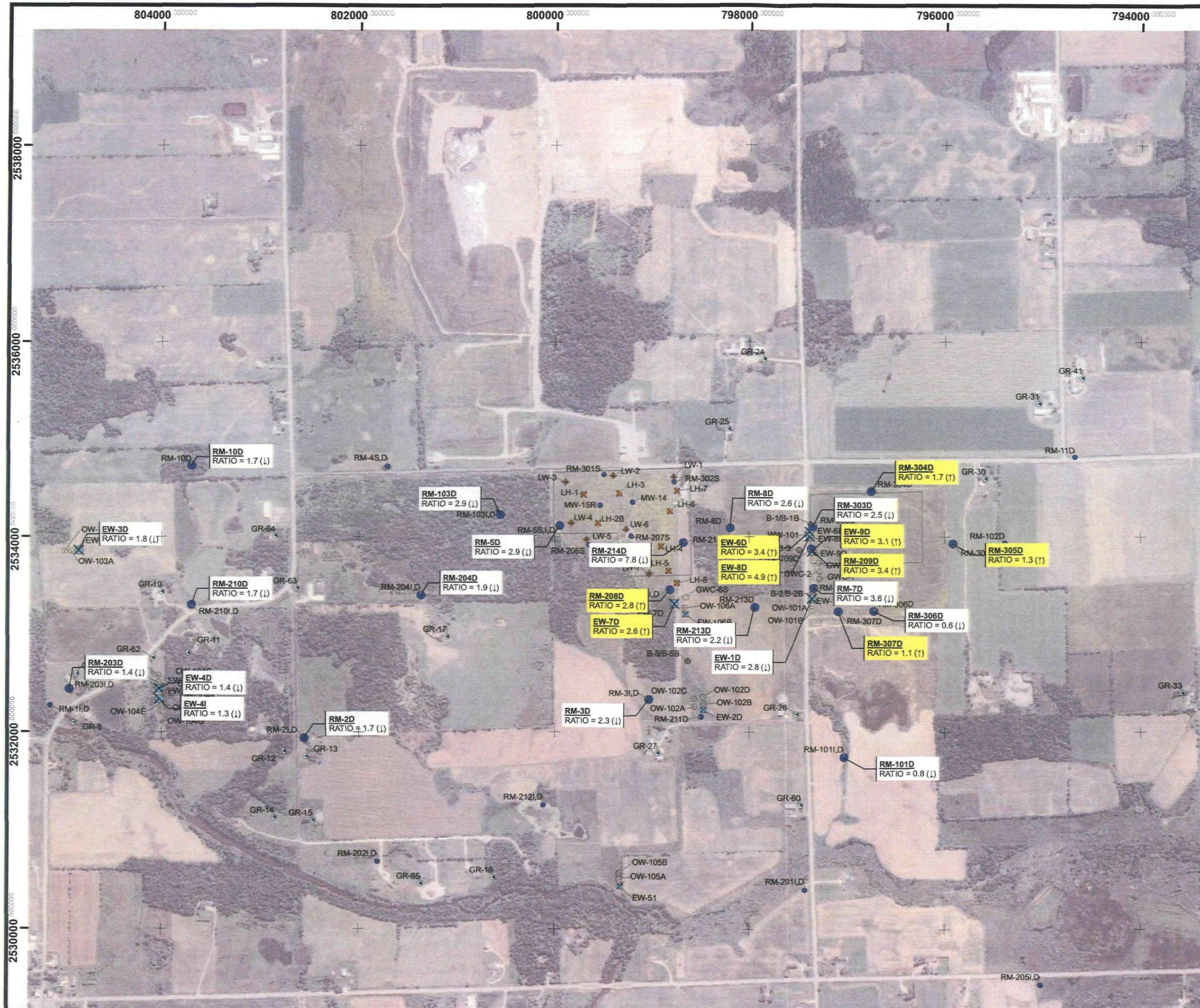
Attachment 8
Map Illustrating Trends and Distribution of DCE/TCE Ratios



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LEGEND

- ⊕ BEDROCK BORING
- ○ GW COLLECTION SUMP
- ✕ GW EXTRACTION WELL; WET WELL
- ⊙ GW OBSERVATION WELL
- ✕ LEACHATE HEAD WELL
- ✦ LEACHATE WITHDRAWL WELL
- ● MONITORING WELL
- ◉ RESIDENTIAL WELL
- ☐ LANDFILL AREA

MONITORING LOCATION SHOWING UPWARD TREND IN cis 1,2 DCE TO TCE RATIO

SAMPLE ID
RATIO OF DCE/TCE (TREND DIR.)

MONITORING LOCATION SHOWING DOWNWARD TREND IN cis 1,2 DCE TO TCE RATIO

SAMPLE ID
RATIO OF DCE/TCE (TREND DIR.)

NOTES

1. AERIAL IMAGERY FROM USDA - NATIONAL AGRICULTURE IMAGERY PROGRAM, 2008.
2. MAP COORDINATES ARE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FEET.

0 1,000 2,000 FEET

1" = 1,000 '
1:12,000

PROJECT: **LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN**

SHEET TITLE: **TRENDS IN RATIO BETWEEN CIS 1,2 DCE AND TCE**

DRAWN BY: PAPEZ J	SCALE:	PROJ. NO.	00-003458.40
CHECKED BY: JR	AS NOTED	FILE NO.	34584001.mxd
APPROVED BY: JW	DATE PRINTED:	**FIGURE 1**	
DATE: APRIL 2009	4/17/2009		

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Attachment 9
Revised Table 8

Table 8
Long-Term MNA Sampling Program

WELL GROUPING/ DESIGNATIONS	SAMPLING FREQUENCY	LABORATORY ANALYTICAL PARAMETERS(1)	FIELD ANALYTICAL PARAMETERS(1)
54 Existing Monitoring Wells: RM-001D, RM-001I, RM-002D, RM-002I, RM-003D, RM-003I, RM-004D, RM-004S, RM-005D, RM-005I, RM-005S, RM-007D, RM-007S, RM-007XD, RM-007XXD, RM008D, RM-010D, RM-011D, RM-101D, RM-101I, RM-102D, RM-103D, RM-103S, RM-201D, RM-201I, RM-202D, RM-202I, RM-203D, RM-203I, RM-205D, RM-205I, RM-206S, RM-207S, RM-208XD, RM-208D, RM-208I, RM-208S, RM-209D, RM-210D, RM-210I, RM-211D, RM-212D, RM-212I, RM-213D, RM-214D, RM-301S, RM-302S, RM-303D, RM-304D, RM-305D, RM-306D, RM-307D, RM-308D	Quarterly (March, June, September and December)	None	Depth to Water
LTR Sentinel Wells: RM-3D(2), RM-211D, RM-212I, RM-212D, RM-2D, RM-210I, RM-210D, RM-203I, RM-203D	Quarterly (March, June, September and December)	VOCs (incl. ethane, ethane, methane) Alkalinity, chloride, Manganese, Nitrate, Nitrite, Sulfate, and TIC	CO_2, ORP, pH, Temperature, Specific conductivity, Turbidity, DO
LTR Near-Field Wells: RM-303D, RM-209D, RM-7S, RM-7D, RM-7XD, RM-7XXD, RM-8D, RM-214D, RM-208D, RM-208XD, RM-5D	Quarterly (March, June, September and December)	VOCs (incl. ethane, ethane, methane) Alkalinity, chloride, Manganese, Nitrate, Nitrite, Sulfate, and TIC	CO_2, ORP, pH, Temperature, Specific conductivity, Turbidity, DO

Table 8
Long-Term MNA Sampling Program

WELL GROUPING/ DESIGNATIONS	SAMPLING FREQUENCY	LABORATORY ANALYTICAL PARAMETERS[1]	FIELD ANALYTICAL PARAMETERS[1]
LTR Plume Wells[3]: RM-305D, RM-306D, RM-304D, RM-307D, RM-101D, RM-213D, RM-103D, RM-204I, RM-204D	Semiannually (March, September)	VOCs (incl. ethane, ethane, methane) Alkalinity, chloride, Manganese, Nitrate, Nitrite, Sulfate, and TIC	CO_2, ORP, pH, Temperature, Specific conductivity, Turbidity, DO
LTR Plume Wells: RM-11D, RM-102D, RM-308D, RM-101I, RM-3I, RM-208S, RM-208I, RM-5I, RM-103S, RM-4S, RM-4D, RM-2I, RM-10D	Annually (September)	VOCs (incl. ethane, ethane, methane) Alkalinity, chloride, Manganese, Nitrate, Nitrite, Sulfate, and TIC	CO_2, ORP, pH, Temperature, Specific conductivity, Turbidity, DO
LL Wells[4]: RM-301S, RM-302S, RM-207S, RM-206S, RM-5S	Annually (September)	VOCs (incl. ethane, ethane, methane) Alkalinity, chloride, Manganese, Nitrate, Nitrite, Sulfate, and TIC	CO_2, ORP, pH, Temperature, Specific conductivity, Turbidity, DO
LTR Sentinel Wells: RM-3D[2], RM-211D, RM-212I, RM-212D, RM-2D, RM-210I, RM-210D, RM-203I, RM-203D	Annually (September)	SVOCs, metals, cyanide	CO_2, ORP, pH, Temperature, Specific conductivity, Turbidity, DO
Residential Wells: GR-13, GR-14, GR-15, GR-25, GR-26, GR-27, GR-60R,	Semiannually (March, September)	VOCs	ORP, pH, Temperature, Specific conductivity, Turbidity
GR-8, GR-9, GR-10, GR-11, GR-12, GR-16, GR-17, GR-24, GR-30, GR-31, GR-33, GR-41, GR-62, GR-63, GR-64, GR-65	Annually (September)	VOCs	ORP, pH, Temperature, Specific conductivity, Turbidity

Notes:
[1] = MNA laboratory and field-analytical methods and reporting limits are listed in Table 3 of the MNA Summary Report.
[2] = RM-3D moved from annual to quarterly sampling, per USEPA request.
[3] = *This list of LTR plume wells moved from annual to semi-annual, per WDNR request.*
[4] = RM-301S, RM-302S and RM-5S are located inside of the LL slurry wall.

VOCs = Volatile organic compounds, laboratory analyzed via EPA Method 8260B.
TIC = Total Inorganic Carbon.
CO_2 = Carbon dioxide.
ORP = Oxidation-reduction potential.
DO = Dissolved oxygen.

Attachment 10
Revised Figures

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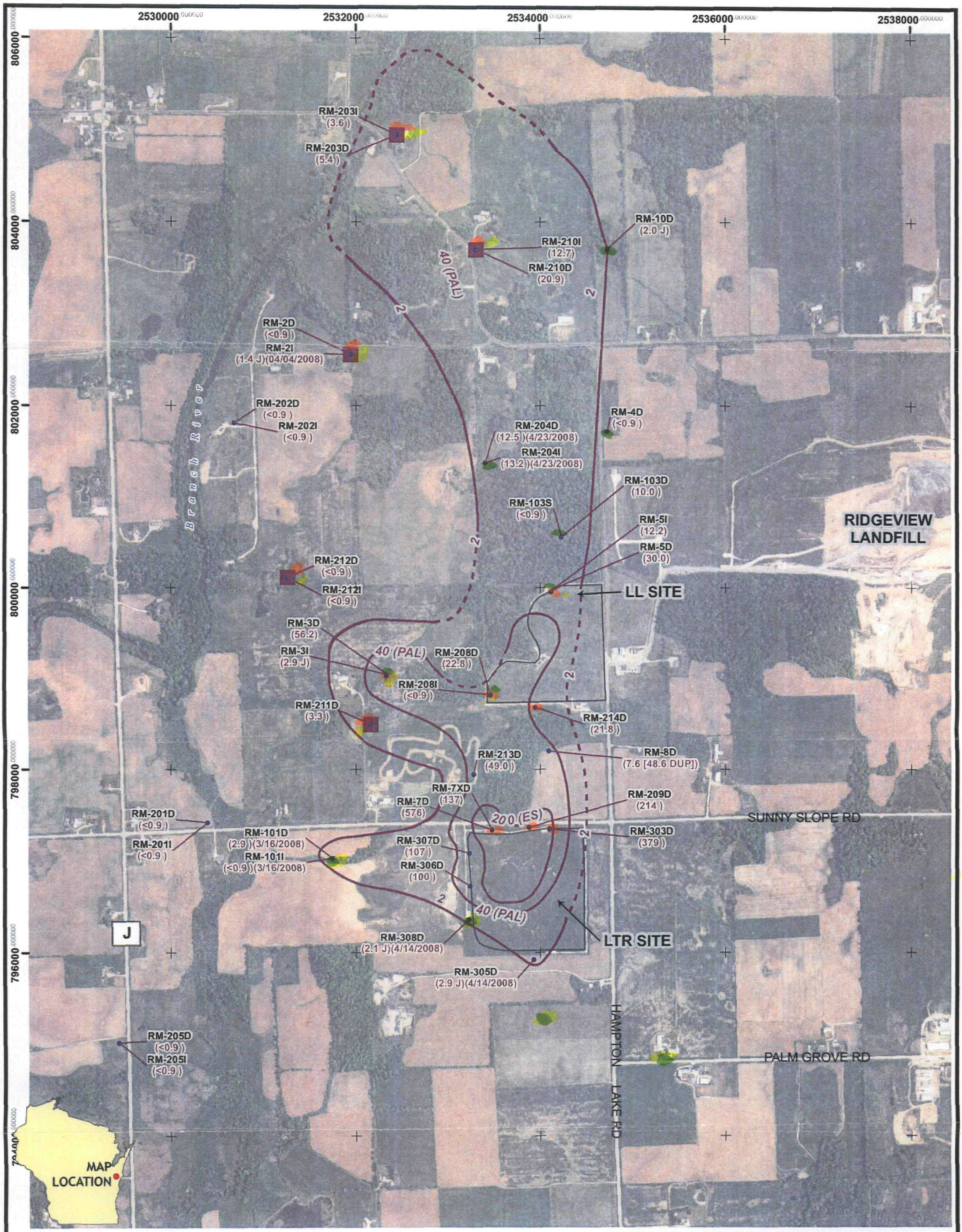

LEGEND

- MONITORING WELL
- SENTINEL WELLS
- 20 1,1,1-TCA ISO-CONCENTRATION (DASHED WHERE INFERRED)

1,1,1-TCA SAMPLES USED FOR ISO-LINES
LABELS SHOW CONCENTRATION (UG/L) AND SAMPLE DATE IF SAMPLE WAS TAKEN EARLIER THAN JULY 2008

RM-208
(825.53)

- LANDFILL AREA

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. J OR Q = RESULT IS BETWEEN THE LOD AND LOQ.
4. 1,1,1-TCA WAS NOT DETECTED IN RESIDENTIAL WELL SAMPLES DURING THE REPORTING PERIOD; RESIDENTIAL WELL RESULTS ARE NOT USED FOR CONTOURING.

N

0 1,000 FEET
1" = 1,000'
1:12,000

PROJECT: LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN			
SHEET TITLE: 1,1,1-TCA CONCENTRATIONS LGU AND BEDROCK UNIT-JULY 2008			
DRAWN BY: MCKEEFRY J	SCALE:	PROJ. NO. 00-03457.46	
CHECKED BY: THC	AS NOTED	FILE NO. 34574606.mxd	
APPROVED BY: JDW	DATE PRINTED: 12/22/2008	FIGURE 2	
DATE: DECEMBER 2008			

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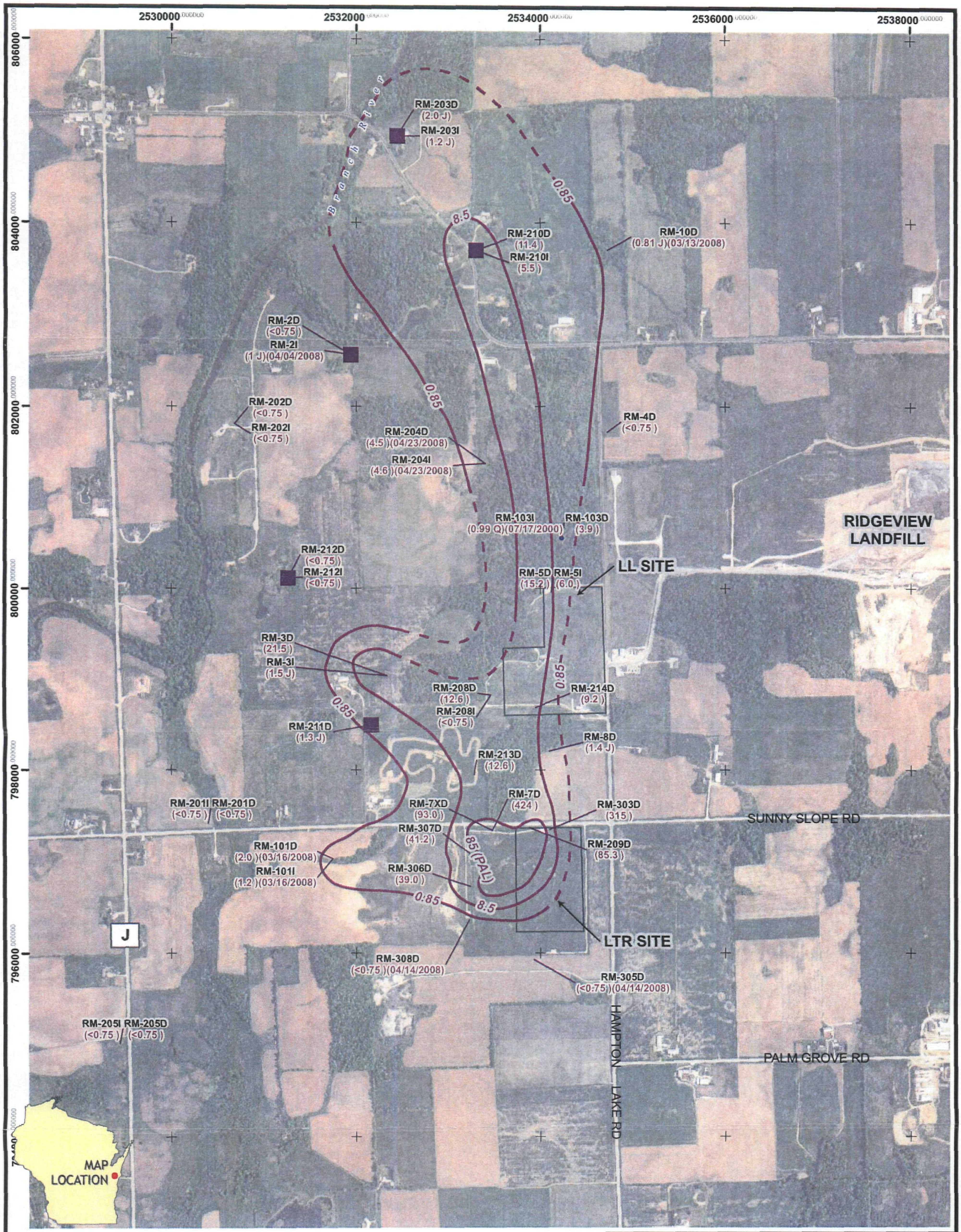
Proposed quarterly sampling (59)
Proposed semi-annual sampling



LEGEND

- MONITORING WELL
- SENTINEL WELLS
- 8.5 1,1-DCA ISO-CONCENTRATION *(DASHED WHERE INFERRED)*

1,1-DCA SAMPLES USED FOR ISO-LINES
LABELS SHOW CONCENTRATION (UG/L) AND SAMPLE DATE IF SAMPLE WAS TAKEN EARLIER THAN JULY 2008

RM-212D
(<0.48)

- LANDFILL AREA

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. J OR Q = RESULT IS BETWEEN THE LOD AND LOQ.
4. 1,1-DCA WAS NOT DETECTED IN RESIDENTIAL WELL SAMPLES DURING THE REPORTING PERIOD; RESIDENTIAL WELL RESULTS ARE NOT USED FOR CONTOURING.

0 1,000 FEET
1" = 1,000'
1:12,000
N

PROJECT: LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES
TOWN OF FRANKLIN, WISCONSIN

SHEET TITLE: 1,1-DCA CONCENTRATIONS
LGU AND BEDROCK UNIT-JULY 2008

DRAWN BY: MCKEEFRY J	SCALE:	PROJ. NO.	00-03456.44
CHECKED BY: THC	AS NOTED	FILE NO.	34574607.mxd
APPROVED BY: JDW	DATE PRINTED:	FIGURE 3	
DATE: DECEMBER 2008	12/22/2008		

RMT

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

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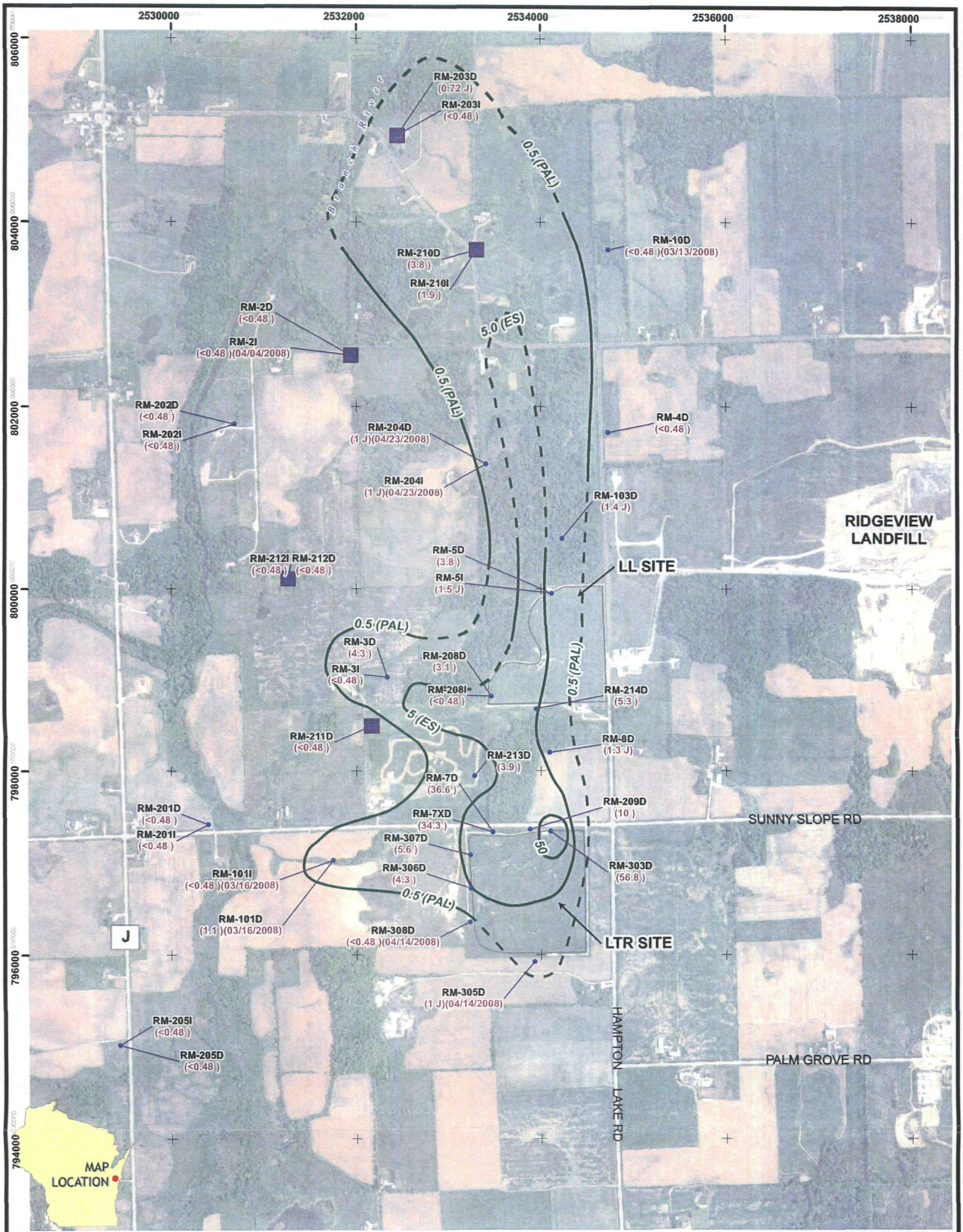

LEGEND

- MONITORING WELL
- SENTINEL WELLS
- 5 —— TCE ISO-CONCENTRATION *(DASHED WHERE INFERRED)*

TCE SAMPLES USED FOR ISO-LINES
LABELS SHOW CONCENTRATION (UG/L) AND SAMPLE DATE IF SAMPLE WAS TAKEN EARLIER THAN JULY 2008

RM-212D
(<0.48)

LANDFILL AREA

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. J OR Q = RESULT IS BETWEEN THE LOD AND LOQ.
4. TCE WAS NOT DETECTED IN RESIDENTIAL WELL SAMPLES DURING THE REPORTING PERIOD; RESIDENTIAL WELL RESULTS ARE NOT USED FOR CONTOURING.

N

0 1,000 FEET

1" = 1,000'
1:12,000

PROJECT: **LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN**

SHEET TITLE: **TCE CONCENTRATIONS LGU AND BEDROCK UNIT-JULY 2008**

DRAWN BY: MCKEEFRY J	SCALE:	PROJ. NO.	00-03458.40
CHECKED BY: THC	AS NOTED	FILE NO.	34584005.mxd
APPROVED BY: JDW	DATE PRINTED:	**FIGURE 4**	
DATE: APRIL 2009	4/10/2009		

RMT

744 Heartland Trail
Madison, WI 53717-1934

P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

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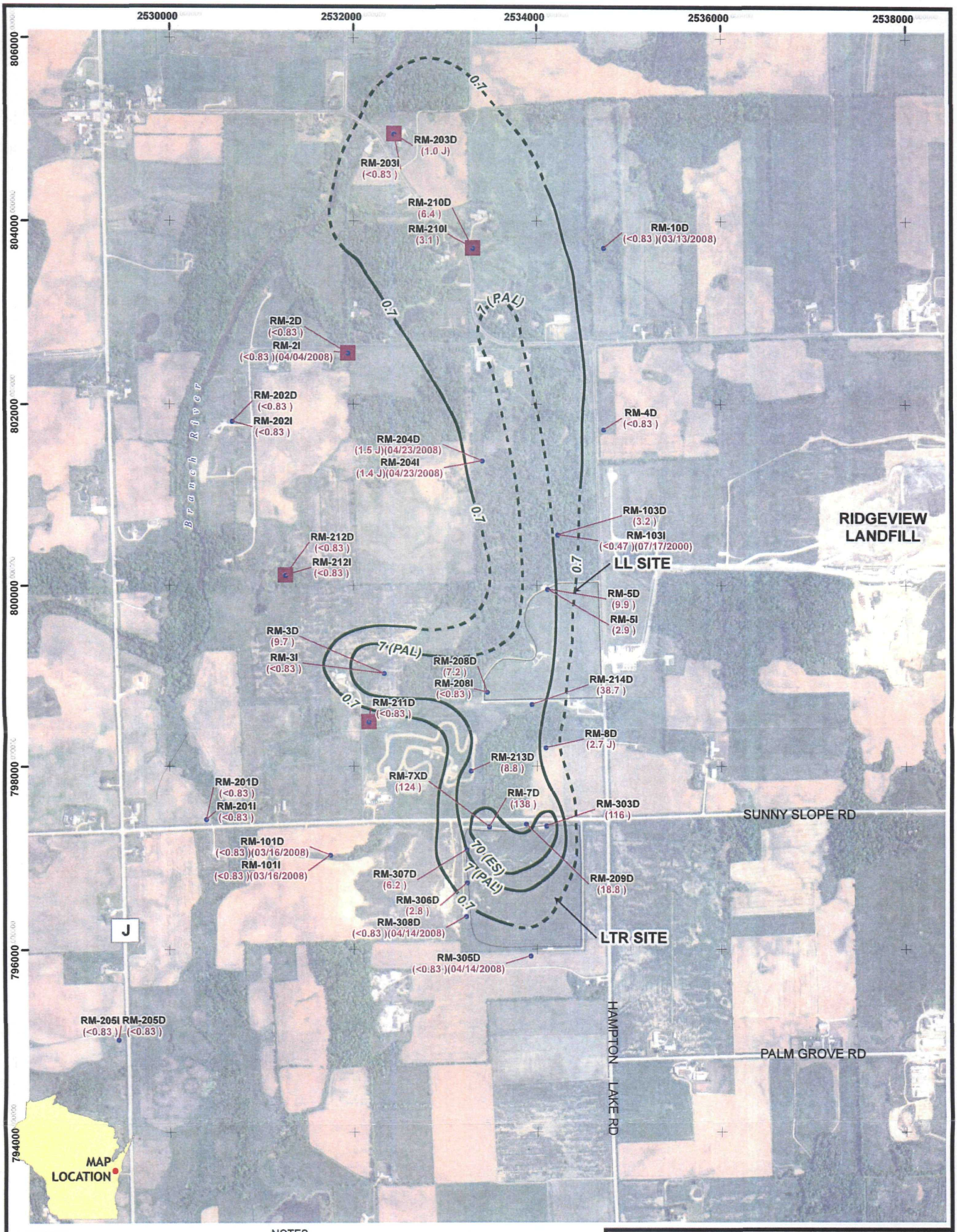

LEGEND

- MONITORING WELL (RM)
- SENTINEL WELLS
- 20 CIS-1,2-DCE ISO-CONCENTRATION (DASHED WHERE INFERRED)

CIS-1,2-DCE SAMPLES USED FOR ISO-LINES
LABELS SHOW CONCENTRATION (UG/L) AND SAMPLE DATE IF SAMPLE WAS TAKEN EARLIER THAN JULY 2008

RM-208
(825.53)

- LANDFILL AREA

NOTES

1. AERIAL IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM 2005.
2. MAP COORDINATES REFERENCE WISCONSIN STATE PLANE, SOUTH ZONE, NAD 83, US SURVEY FOOT.
3. J OR Q = RESULT IS BETWEEN THE LOD AND LOQ.
4. CIS-1,2-DCE WAS NOT DETECTED IN RESIDENTIAL WELL SAMPLES DURING THE REPORTING PERIOD; RESIDENTIAL WELL RESULTS ARE NOT USED FOR CONTOURING.

N

0 1,000 FEET
1 " = 1,000 '
1:12,000

PROJECT:	LEMBERGER LANDFILL AND LEMBERGER TRANSPORT AND RECYCLING SITES TOWN OF FRANKLIN, WISCONSIN		
SHEET TITLE:	CIS-1,2-DCE CONCENTRATIONS LGU AND BEDROCK UNIT-JULY 2008		
DRAWN BY: MCKEEFRY J	SCALE:	PROJ. NO.	00-03458.40
CHECKED BY: THC	AS NOTED	FILE NO.	34584007.mxd
APPROVED BY: JDW	DATE PRINTED:	FIGURE 5	
DATE: APRIL 2009	4/10/2009		

RMT
744 Heartland Trail
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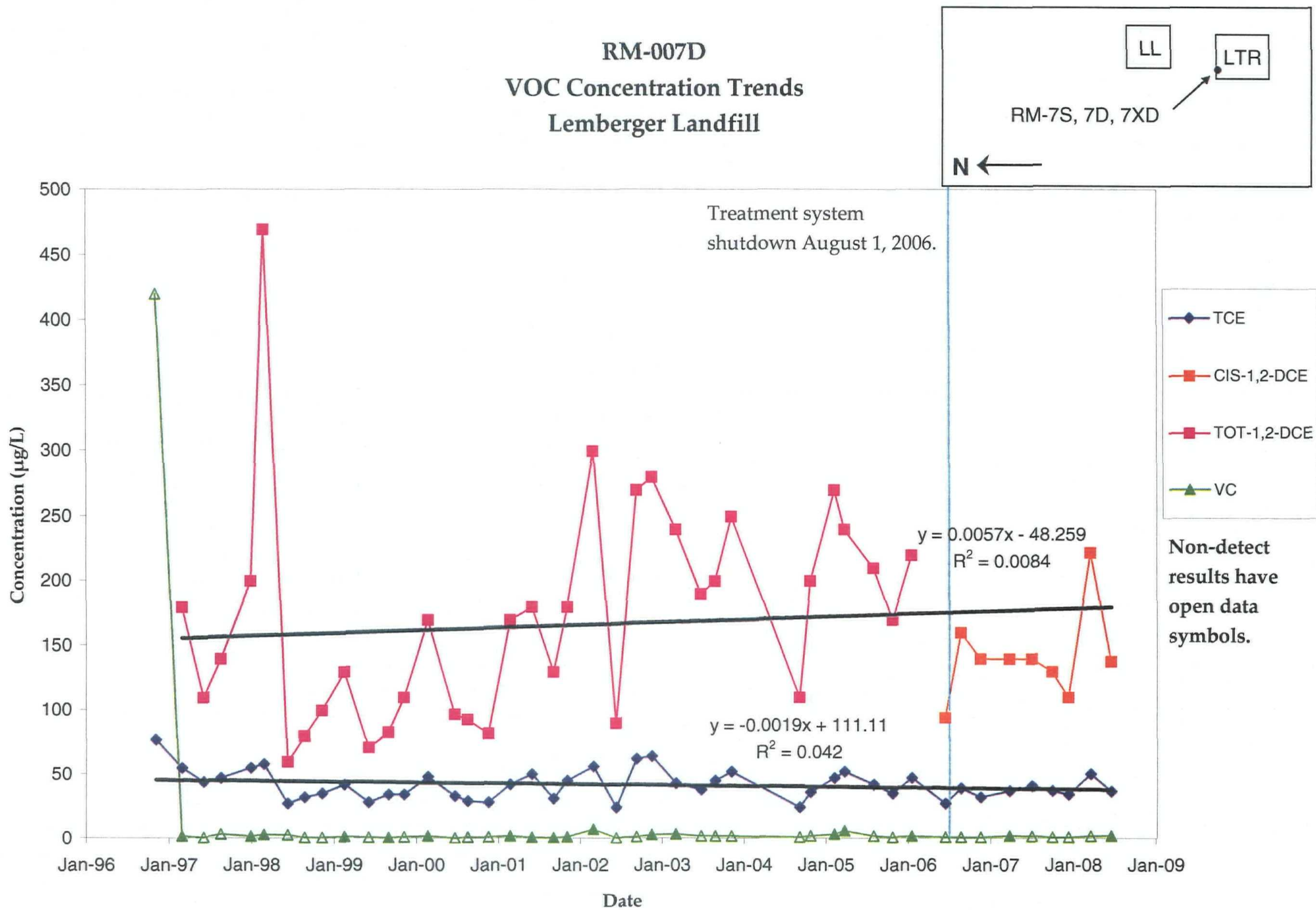
Attachment 11
Select Graphs of Chlorinated Ethenes With Trend Lines Added



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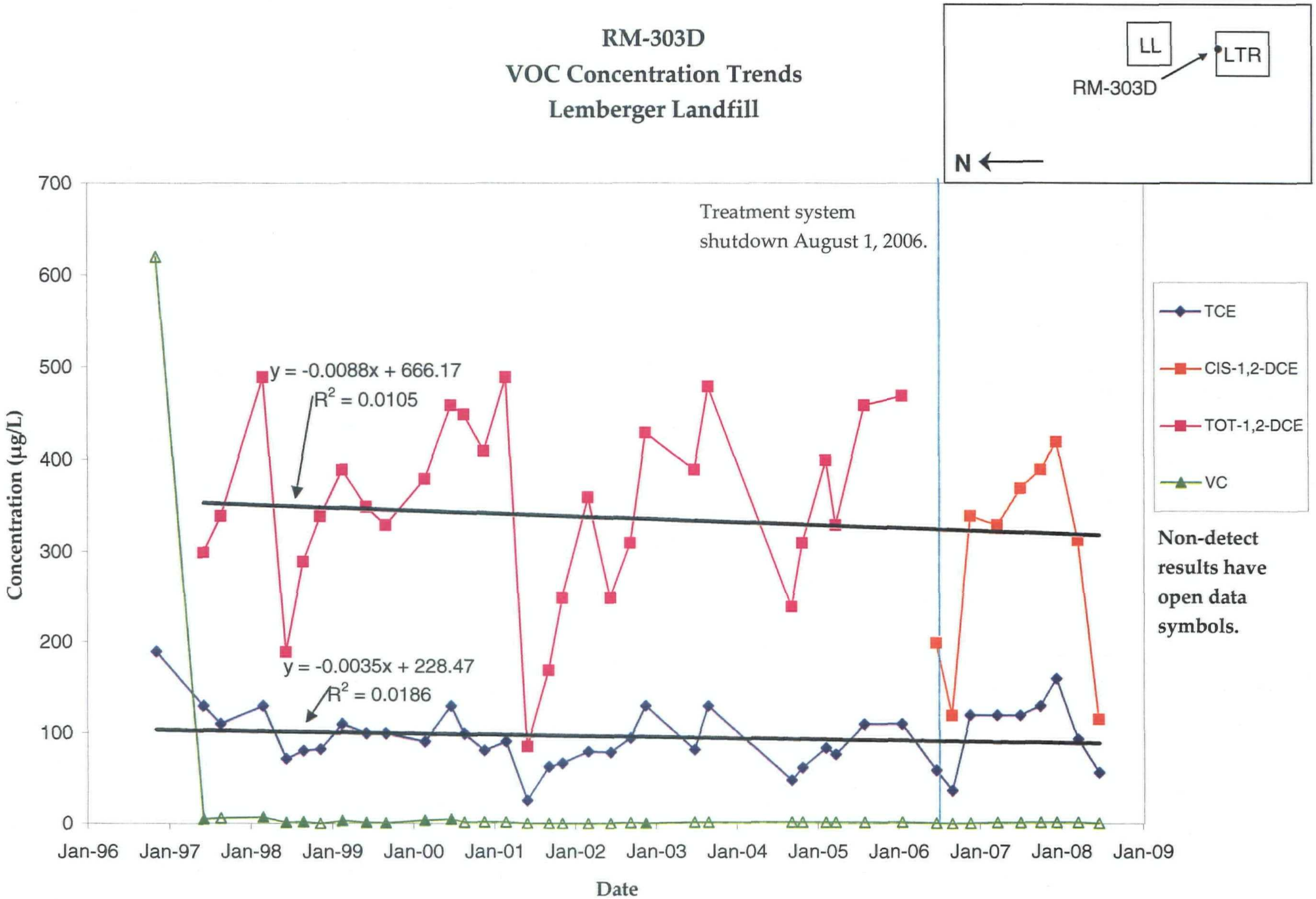

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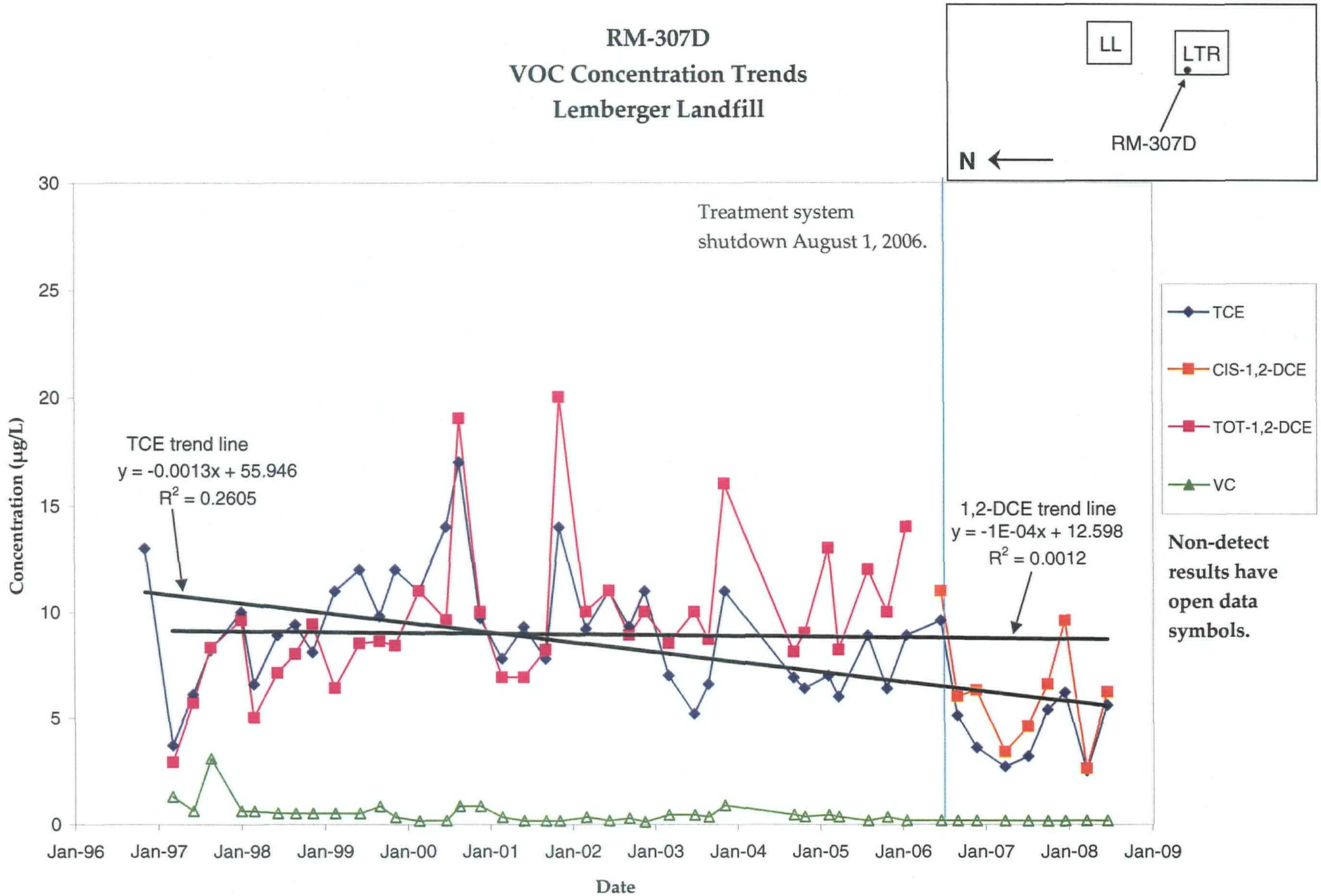
RM-307D
VOC Concentration Trends
Lemberger Landfill



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Attachment 12

Trans-1,2-DCE Data

	SAMPLEID	SAMPLEDATE	PARMNAME	CONC	UNITS	QUAL
1	RM-103S	1996-12-02 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	1	UG/L	J
2	RM-303D	2006-09-28 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	1.5	UG/L	Q
3	RM-103S	2006-12-15 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	1.0	UG/L	Q
4	RM-103S	2007-11-01 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	1.3	UG/L	Q
5	RM-103S	2008-01-15 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	1.3	UG/L	Q
6	RM-103S	2008-04-07 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	0.92	UG/L	J
7	TRIP BLANK 1	2008-08-21 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	0.89	UG/L	NULL
8	RM-007D	2008-10-30 00:00:00.0...	TRANS-1,2-DICHLOROETHE...	6.7	UG/L	J